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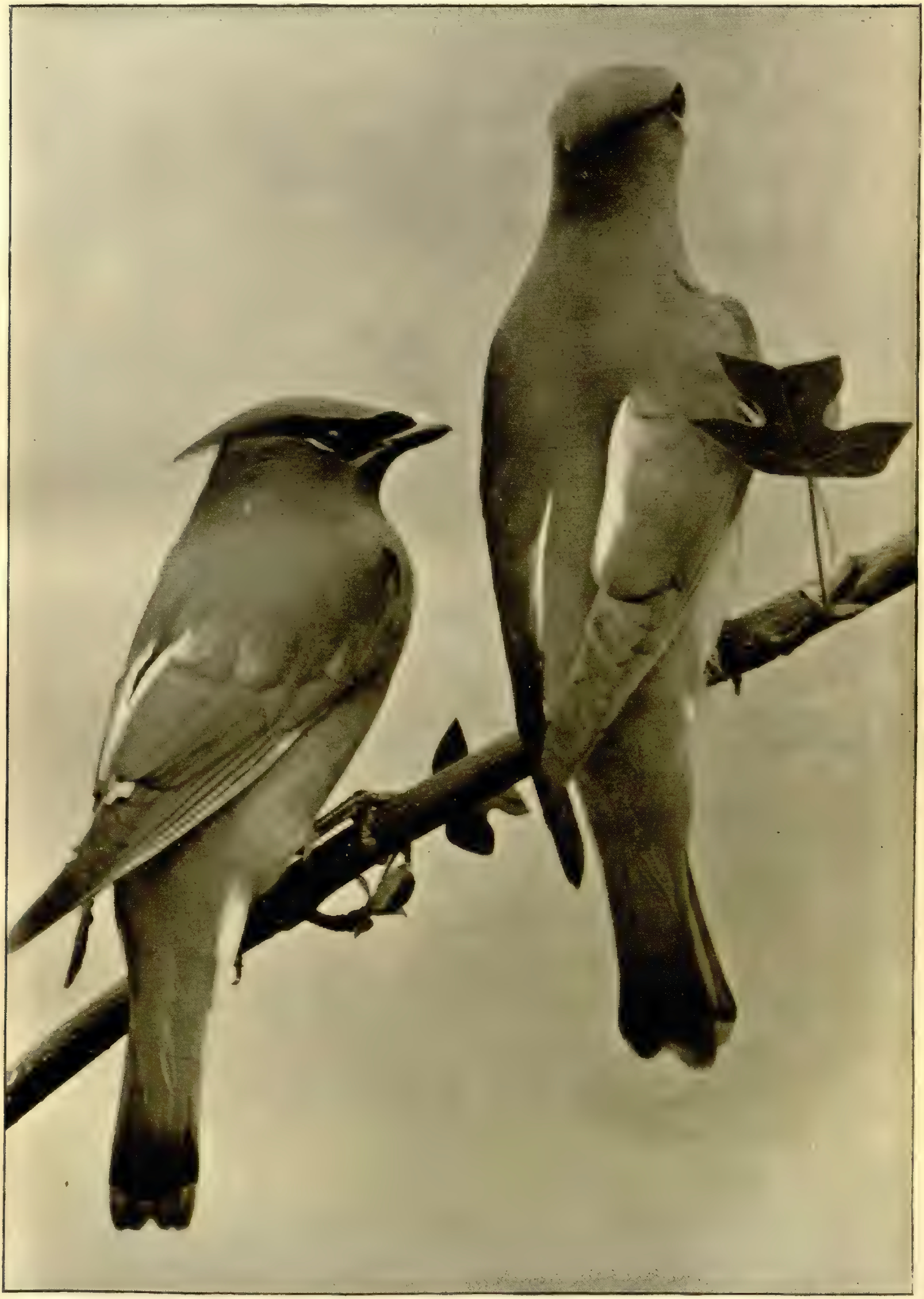

Ampelis cedrorum from life.

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A GROOVED STONE AXE FROM THE OHIO DRIFT.

BY H. C. MERCER.

Mr. E. W. Claypole in the American Geologist for November, 1896, says that Mr. Elmer E. Masterman, in the summer of 1896, found a grooved greenstone axe of common aboriginal American type, *in situ*, twenty-two feet down in a deposit of what Mr. Claypole regards as glacial gravel, near New London in southeast Huron County, Ohio. The latter quotes the finders narrative which declares that he, Masterman, while digging a well, without witnesses, found the axe bedded in a stratum of tough blue clay, in which, after removal, it left its impress. Above it rested one foot of coarse gravel, covered by thirteen feet of silty material banded with films of sand, and overlaid finally by a superficial covering eight feet thick of clay and stones.

Mr. Claypole who has wisely examined the case on the spot, cites in favor of the genuineness of the discovery, the extraordinary decomposition of the greenstone specimen, which when sawed in half was found to be rotted or leached (he thinks by contact with sulphurous water) almost entirely through its interior, a process lasting probably a long time, while a series of concentric limonite stains like the year marks on a stump, exposed on the sawed cross section, seemed further to testify to the long continuance of the work of disintegration, and preclude, in Mr. Claypole's opinion, the fear of "doctoring" as by any of the artificial processes used to patinate or age flints in England and France.

On the other hand, further data furnished by Masterman and fairly cited by Mr. Claypole invite doubt. Masterman is a collector who has been gathering specimens for the last ten years "at various depths in the gravel" without having made the fact generally known to archeologists, namely: *a green stone celt*, not much leached, five feet deep in the clay, in 1889; *a green stone axe*, somewhat leached, in 1882, seven feet deep in the gravel; *a partly finished celt*, not leached, chipped, and a little polished, in 1895, marked "13 ft. deep in the gravel;" *a large chipped shovel-shaped blade* of veined slate, found by Mr. D. White, on July 14, 1884, five feet deep in the gravel, and given to Mr. Masterman; *a spear-head of red flint*, found at a depth of seven feet while digging another well, together with other specimens believed by their discoverer to be of glacial age, while it is further stated that in the well where the axe in question was found Masterman had previously unearthed at a considerable depth in the gravel *a small arrow or spear-point of white stone.*

If the gravel deposit at New London is really glacial drift, and if the objects enumerated above have been found in it *in situ*, let us hope that further discoveries will follow as they have followed the first findings at the important drift beds of Europe. Let us hope that Mr. Claypole has prepared Mr. Masterman for a temporary preservation of the records in future, and for the calling in of witnesses, while it may be supposed that not a few archeologists would gladly sieze the opportunity of hurrying to New London on wire, to see an exposure of the gravel where one or more signs of human handiwork could be shown protruding from the stratified drift, or where, as at Caddington or Hoxne, Chelles, Amiens or Abbeville the discovery of other such objects could be reasonably guaranteed. Should the evidence become generally satisfactory we need not be troubled because the object thus found in American drift is polished, while all blades of human handiwork till now procured from

European drift are chipped and never polished, since though much evidence has been accumulated to show that man chipped before he polished stone in Europe, the testimony of Africa, Asia and America is not yet in upon such sequence in the development of the stone craft of primitive man.

THE BIOLOGIC ORIGIN OF MENTAL VARIETY, OR HOW WE CAME TO HAVE MINDS.

By Herbert Nichols.

Continued from Vol. XXX, p. 975).

The widely popular theory of like nerve currents having been put out of the field, it remains for us to examine the rival one that the afferent nerve currents differ correspondingly with the forms of sense which they mediate. Before doing so it is well for us at this point to recall the main purpose of this paper as a whole, and the somewhat tortuous course of its investigations from the beginning. Our main object, as our title states, is to discover how man came to have such a mind as he now has; or, put otherwise, to discover the origin of our mental diversity and its relationship to our organic evolution. At the outset we found it doubtful whether protoplasmic life originated with one sense or with many. We next determined that molecular differences, underlying our various senses, must have been determining factors of their own selection and survival, and that therein, when rightly followed out, must lie the key to the secrets we are in search of. Alternative theories regarding these molecular differences then presented themselves, one of which we were enabled to dispose of. And we are now left with the probability that the afferent nerve-currents differ correspondingly with the forms of sense they mediate, and with the task of examining what light this fact sheds on the origin of our minds, and on the question whether life began with many senses or with one.

Thus reoriented in our work, it must be observed that our remaining hypothesis also divides into alternative possibilities. Granting that the currents in the afferent nerves are diverse, still it remains possible either: That they may continue on, through the end-organ processes, each preserving its distinguishing characteristic or phase of molecular activity till, at last, it articulates directly with its appropriate external stimulus. Or, that they may specifically terminate in the end-organs, and be linked, thence onward, to their outer stimuli by one or more intermediate processes. These, if I am not mistaken, are the ultimate alternatives which remain for the solution of our problem.

To decide whether, on the one hand, the afferent currents do preserve their specific nature through the end-organs, till they articulate with the external forces, or if, on the other, intermediate activities come between them and these last, is, therefore, a crucial point in our investigations, and one of the important crux of our science. Unfortunately, however, it is one that the world's present stock of knowlege is unable to determine, and one that this paper must leave for future investigation. The best authorities of our day present arguments on both sides, and too few facts of any kind are known to make any of them even approximately conclusive. Within the sphere of vision, the theories of Helmholtz, Herring, Ebbinghaus and Mrs. Franklin all demand intermediate retinal processes between the light vibrations and the neural conditions which must be conceived to be correspondent to the final color-pictures. On the other hand it is the notion of Prof. Wundt that the various color-currents result immediately from diverse functions of the light vibrations as they fall on the ends of the optic fibrils in the retina; and Prof. Cattell and many others incline to follow this opinion. In the sphere of hearing it is well determined that the sound-waves do not break immediately on the ends of the auditory fibres; yet it is difficult even to guess whether the final stimulus is a mediatory form of mechanical vibration, or is some unknown and perhaps chemical process set-up in the end-cells in which the auditory fibrils terminate. Still less is known regarding smell and taste, save that chemical processes, mediate or immediate, are here certain, and make the possibility of their being involved in other end-organ processes the more likely, and, therefore, the more confusing. The question whether temperature acts directly on the nerves of heat and cold is again illustrative of the difficulties of our end-organ problem. The wide diversity of stimuli that, apparently, affect the pain nerves is also perplexing. And finally the fact that all sorts of artificial stimulation of the cut stumps of the sensory nerves—pricking, pressing, burning, and the application of ice, electricity and various chemicals—alike produce the one customary effect, sets the task of deciding definitely as to the initiation of sensory impulses entirely in the future.

While it is thus impossible for us to determine the nature of the end-organ processes by positive evidence of their present condition, there still remains the wide field of their morphology, which ought, if we could understand it, to reveal both their nature and their evolutionary history. But here again we find ourselves among uncertainties. The best we may do, therefore, in survey of the final hypotheses among which future science must find the ultimate truth, is to set in order the loose-ends of their several, at present, indeterminable possibilities, somewhat categorically, and with brief enumeration of the conditions involved in each. In so doing, we reach the limits of what should be expected regarding these matters within the limits of this entirely prospective paper.

As a step to this end, it is necessary to recognize still one other source of difficulty. While all problems of physiological morphology are much complicated by uncertainty whether we must be guided therein by Weismann or by Lamarck, we must anticipate peculiar difficulties from this source, in our present problem. We become aware of this the moment we weigh our two main propositions in view of these rival biologic principles. If life began with one primary sense and developed our various ones at successive periods, the cue for this development would be different under the one theory than under the other. If Weismann is to be followed we must depend chiefly on spontaneous variations; in which case we must estimate the difficulties of new specific energies being born into the central nervous system at different epochs, and finding serviceable articulation with environmental exigencies by means of the nerves and end-organs. If Lamarck is to guide us, then we must think of the various external forces as playing upon the surface of the developing organism, and modifying the nerve currents through to their central terminations in agreement with their own molecular, or molar characteristics and peculiar needs. The course of morphologic development would be oppoposite in the two cases. In the first, the variations would begin in the nerve centers and make their way to the surface. In the second, the modifications would work from the surface, inward. Until a decision may be reached, therefore, between these two great morphologic principles, we shall be obliged, in estimating the probable mode of origin of our senses, to keep up a double system of conjecture on this score, as well as on others.

Its many difficulties having been set before us, we can now formally sum up, under its remaining contingencies, what may be called the residuary outlook of our general problem. We have remaining our two main postulates, that life began (O) with one sense or (M) with many ; our belief that the afferent nerve currents are diverse ; the alternatives that these currents articulate (d) directly, or (i) by intermediate end-organ processes ; and the two evolutionary principles, (w) the Weismannian and (l) the Lamarckian. With these before us, we have to cast up the possibilities of our mental origin under the combinations offered by their several limiting determinations.

Beginning with the postulate, ‘ O ’ of one primary sense, and the doctrine ‘ d ’ of direct articulation, the course of morphologic history may be prospected as follows :

($\mathrm{O}\underline{\mathrm{d}\ {}^{\mathrm{w}}}$). Under the Weismannian principle we may conceive that, from time to time, neural variations appeared, making possible certain molecular activities (sense-energies) whose respective peculiarities were diversely adapted to different environmental forces, and to physiological congruency and maintenance within the creatures own organism ; and which variations, therefore, were rejected or perpetuated according to the sum total of their fitness within the five spheres of evolutionary selection pointed out in our preliminary investigations. Looking upon our own sensory equipment as the outcome of this process, we must conceive each present coupling of sense and appropriate stimulus to be one that has existed unaltered since the first appearance of that sense. As an example of this we must conceive, that although many primitive creatures display actinic susceptibility, yet they experience thereby no such color sensations as we do; that these last were born in to the line of our ancestry at an unknown period, (not necessarily coincident with the appearance of eyes); and that the rise of serviceable end-apparatus has gradually specialized the neural basis of these sensations to a coupling with certain ranges of ether-vibration called light.[1]

(O$^{\underline{d\ 1}}$). Under the Lamarckian principle we may conceive that the diversity of environmental forces played on the developing organism, from without, each in a way tending to modify the nervous mechanism to its own peculiarities and needs, and to mould the total organism in accord with its net functional efficiency within, again, our full five evolutionary spheres. In this case it would be extremely difficult to determine whether the sort of sense that now responds to any given stimulus, let us say light, is at all like that which responds to the same stimulus in primitive creatures. An actual example of this mode of development may possibly be found in the history of our ears; that is, if as Prof. Lloyd Morgan has suggested, gross vibrations, such as rolling the body, were the appropriate stimuli for the cilia of the otic organs at a primitive stage of development, a crude sense of equilibrium being the psychic result; and if our present hearing has come about by perfecting adjustment of these organs, continuously, to finer and finer vibrations, while a correspondent change took place in respondent sensations.

Starting again with the same postulate of one primary sense, we must next couple it with the doctrine of intermediate articulative processes in the end-apparatus.

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[1] Since there is evidence that amorphous creatures react to various stimuli, if we suppose but one primitive sense, we must conceive that it responds, alike, to several forces. Also similarly for each newly appearing sense. Under these conditions, the narrowing of each of our senses to its present stimulus, is to be explained by morphologic specialization.

$(O\underline{i\ w})$. Under the Weismannian principle, we may conceive the same general plan of developnent to have proceeded, here, as formerly under this principle $(O\underline{d\ w})$ with reference to the birth of each new sense, but with a more complicated programme with reference to the couplings of inner sensations with different outer forces, at different periods. Relative to this last we may observe that, since the permanency of intermediate articulations must depend on the permanency of the organs that perform them, therefore it is not likely, that the precise couplings now obtaining in us were constant or, perhaps, occurred at all before these organs developed. Under these conditions it would be even more difficult to follow the history of our sense-origins, than under the method of our last above paragraph. The method of this present paragraph, however, may be exampled, if it should prove true that the phenomena of color-blindness are due to the failure of birth in certain people and species, of neural variations sufficiently differentiated to be responsive to the solar waves in the fuller way exhibited in our normal color spectrum. Something like this is demanded to explain the origin of color sensations under Prof. Wundt's theory of vision.

$(O\underline{i\ l})$. Under the Lamarckian principle, as under the Weismannian, the intermediate processes would but complicate the general plan of evolution outlined under direct articulation $(O\underline{d\ l})$. And again the Morgan explanation of otic morphology may serve as an example, except that now we should no longer conceive vibration of the otic cilia to have direct determination of the auditory impulses; but should be obliged to consider certain as yet undetermined mediatory processes, including, perhaps, unknown chemical activities in the otic cells.

The last above four paragraphs exhaust, if I mistake not, the evolutionary possibilities under the postulate that life began with one sense; the central idea in each case being that our several senses have risen at successive periods, and that for each of them the peculiar fitness of its underlying neural correspondence has been the ultimately determining factor of its birth and selective perpetuation from among other possible senses, and also of its connection with its present stimulus.

Turning now to the postulate of many primary senses, we have no longer to account for the birth of new senses. Our problem, here, is to determine how our present senses were shut in, and all others shut out; and this is the problem of the origin of our sense *organs*, and of the establishment and perpetuation of the articulate processes, mediate or intermediate which they perform.

($\mathrm{M}^{\underline{d\ w}}$). The Weismannian principle, here, of course can have no immediate bearing on the birth of different senses, since all of ours, and many more are supposed to have existed originally. Under this postulate taken with the doctrine of "through currents directly articulate," our problem would be at its simplest; for the same couplings of senses and stimuli that exist now are likely to have continued, fixedly, from the beginning. The perpetuation of any particular sense, under these conditions, must have been decided jointly, on the one hand, by the need which the developing organism had of being adjusted to certain environmental forces rather than others; and on the other, by the capability of the organism to fit itself to, and to maintain the peculiar neural modes (energies) correspondingly to these forces. As examples of this sort of development we should explain the skin to be a peripheral organ which has preserved our sensibility to heat and to cold through the profitability of preserving the developing creature from temperature extremes, at the expense of losing sensibility to an unknown number of other forces. Or perhaps, and as I suspect this is a far more profound statement, it may quite well have been that it was the adaptability of certain molecular sense-forms for general physiological organization, that originated such organization in lines of their correspondent stimuli, rather than in other lines; as for instance in the line of a creature suspectable to our environmental stimuli, rather than in the line of a creature susceptable, let us say, to electrical influences.

($\mathrm{M}^{\underline{d\ l}}$). Under the Lamarckian principle the reasons for the selection and perpetuation of the particular sense elements, which now make up our mental equipment, would be so similar to those set forth in our last above paragraph, that they need not be here repeated. It is the method of general biologic growth that would be different in these two cases.

Turning again and for the last time to the doctrine of intermediate end-processes, we come as I suspect, under its combination with the postulate of many primitive senses to the particular combination of possibilities most likely to accord with the truth, and which therefore, must solicit the attention of future investigators. Yet for our present purposes of merely scheduling the different possible categories, and the general plan of each, it is perhaps sufficient, after what we have said of the other case, to state of the present ones as follows.

($\mathrm{M}^{\underline{\mathrm{i\ w}}}$). Under the Weismannian principle, with many primitive senses, and complex end-processes, the resulting programme and the reasons therefor should easily be constructed by modifying our third and seventh last above paragraphs. ($\mathrm{O}^{\underline{\mathrm{i\ w}}}$ and $\mathrm{M}^{\underline{\mathrm{d\ w}}}$).

($\mathrm{M}^{\underline{\mathrm{i\ l}}}$). And under the Lamarckian principle the corresponding programme should be easily constructed by modifying paragraphs third, seventh and tenth now last above. ($\mathrm{O}^{\underline{\mathrm{d\ l}}}$, $\mathrm{O}^{\underline{\mathrm{i\ l}}}$, and $\mathrm{M}^{\underline{\mathrm{d\ l}}}$).

Finally we must observe regarding all the above possibilities that it is not *necessary* that any one of them should have prevailed universally. In other words it is logically possible that some one of them should have ruled in the production of one of our senses, and another sense have followed quite a different course. Thus while it is quite possible that light is the direct stimulus of color sensation, as Prof. Wundt thinks, and always has been, yet it may be that the final stimuli for our heat and cold sensations are certain processes of mechanical contractions and expansions among different tissues, which processes are intermediate between the nerve impulses and the physical modes of motion called heat and cold; or, directly the reverse of this may have been true. Moreover it is possible that certain of our above categories may have prevailed at one period, and another at another; though this could not apply to all the categories, some of them being mutually exclusive.

Such is the field of our problem. It is doubtful if there is another that has been equally neglected, or that presents greater confusion. Yet because of its importance there is still required of us to consider what avenues offer themselves for solving its many difficulties; and why it is imperative that its several propositions should henceforth be taken to heart in all practical investigations both of Biology and of Psychology.

By way of establishing the roads of sound attack, certain false paths must be pointed out that, heretofore, have continually led our subject to obscurity and to contempt. Some of the errors here indicated have been made by Biologists, and others by Psychologists; but most of them are made by both alike. Biologists are wont either to underrate the part that mind, or its physical equivalent plays in evolution, or to read into it, everywhere, the same world of psychic life that we ourselves experience. The doctrine of Parallelism is responsible for the first mistake; for in conceiving that all conduct must be accounted for within physical forces alone, there is a tendency to fail of full recognition of the facts themselves. The marvelous *variety* of our mental life is nearly sure to be left out of practical account. Nor is it any excuse for this to say that our notions of "molecular differences" and "specific energies" are vague; for once having adopted Parallelism, it is hardly consistant to ignore the most important factors in the whole course of Evolution, on the ground that they are too complex to reckon with. This is the crucial error made in our problem to-day; for since mind would not be mind without this variety, therefore all that "mind" means in the vast region of conduct, and all that "conduct" means in animal evolution is centered in the problem of specific energies, whether Parallelism be accepted or not. To neglect them is the greatest practical error in modern Biologic Science.

It is scarcely less wrong to read our life into simpler lives. This is done by most investigators of primitive fields, and detracts lamentably from their work. The fault originates in a lack of careful examination of the whole field of possibilities; such an examination as we have followed out in this paper. So long as it is uncertain whether primitive creatures react, sensorily, with many responses or with one; or whether the forces that mould our sensory life now, are the same as governed the analogues of our sense organs during earlier periods; and above all while the world's present "artificial, scholastic and untrue" conceptions of emotion and feeling shall continue to be read into amoeba and protozoa; for so long are gross misinterpretations and fallacies scarcely to be avoided.[2]

Another region of misleading assumption is embraced within current doctrines regarding "unconscious" neural processes, and "subconscious consciousness." It is the accepted attitude

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[2] Examples of these difficulties abound. Already I have spoken of the problem, now become classic, of determining whether fishes hear with their ears, or get only such a sense of equilibrium as we get from the semicircular canals—our canals and our cochlea being both derived from the single otic vesicle of the fish. Of course it must make much difference whether the comparative Psychologist and Biologist, in estimating the conduct of fishes in their sensory environment, credit them with hearing or not.

A similar question is raised in a still more striking manner by a species of Clepsine reported by Prof. Whitman. This creature displays a series of dorsal pairs of segmental sense organs, in graded states of development, all the way from fully developed eyes in the anterior segment, down through organs that show but a bit of pigment imbeded in the skin, to final posterior analogues that can not be distinguished from ordinary dermal organs of touch. The problem here is not only where touch leaves off and sight begins, but also where mechanical pressure leaves off and the sun begins, as a part of the creatures active environment.

Again the ordinary earth worm serves as an example. It *moves* in response to light, heat, odors and such stimuli as in us cause taste and touch. Yet no difference has as yet been discovered among its simple sense-fibres, which apparently are all alike. Until our general problem is somewhat cleared up, the psychic life of this creature must be extremely doubtful, and most easy of misinterpretation by the careless observer.

As we go backward from the worms the difficulties increase, till with amorphous creatures the greatest possible doubt is reached, and we are finally brought to face our two main propositions of many original senses or one. According as the naturalist assumes the one proposition or the other, does he make both the psychic and the environmental life of such creatures either very simple, or toloreably complex.

Also the careless assumption of any one sense or function as necessarily the first, comes in here by way of example. As, for illustration, the assumptions respectively that touch, or taste, or muscle sense, or heat and cold, or pain, or pleasure must have come first; or that the innervation function of central cells must develop before the carrying power of nerves, and perhaps the contractility of muscles develop before either. It by no means follows that such matters may not be legitimately considered, and with results of great value. But in the same way that the discovery of the actinic susceptability of protozoa should make the Biologist cautious against conceiving that sight first comes with the appearances of eyes (the truth being that a sort of incipient sight may prevail previous to the appearance of any special sort of eye apparatus whatever), so the numerous possibilities which we have traced out in this lecture should make one careful in interpretting similar matters along this whole line of Biology and Psychology, of most "good science" to avoid "speculation" on these topics. Yet it is the loosest and most reckless kind of wholesale speculation, to build up the whole of modern Psysiology and Biology on the theory that all but a certain fraction of neural activities are unconscious, while really so little is known of the whole subject. Already, in my last lecture,[3] I have pointed out the evils resulting from doing this in several concrete problems of Physiology. We have now to consider these results in a larger field. The truth is that the right to dub all subcortical neural activics "unconscious," though but little contested since the death of Pfluger, still rests on little else than ill-founded prejudice.[4] And to dub them so on insufficient grounds is to run

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[3] A lecture on "Psychology and Physiology," next preceeding the present one in the course mentioned in note on p. 963.

[4] A crucial departing point for practical errors in all assumption of "unconscious" processes must obviously lie in the criterion applied for deciding whether consciousness is present or not. The tests heretofore applied are always either the "purposeness" of the activity in question, or our "immediate cognizance" of it, in case it is an activity within our body. It is evidence of the surprising ease with which Science is led astray in these matters, that both of these tests prove the shallowest sort of fallacies when properly examined. If by "purposeness" be meant psychologic purposing, or conceiving of the end to be accomplished, by the creature performing the act, and immediately initiatory to its performance, then plainly this is preposterous. Notoriously not all "motor ideas" are of this sort. If "ability" to preconceive the end be meant, then this is more absurd; since it makes the "ability" of consciousness the test, where the presence of consciousness is to be tested. And again if mere conduciveness to some purpose is meant, why then, every iron locomotive and nearly everything else in nature must, by this test, be a "conscious" machine. It is remarkable that such psychologists as Romanes, Profs. Wm. James, Lloyd Morgan and Edward D. Cope should stumble into such a visible pitfall in matters of such grave importance.

Regarding the other "test"—*i. e.* of our "immediate cognizance" of our bodily processes—it may first be noted that we are never "directly conscious" of any of our bodily processes, not even of those cortical activities supposed most immediately to underlie *our* conscious states. And next it should be noted that the question is not at all of *our* being conscious of any of these doubtful processes, (for instance, of certain activites of some of the lower nerve-centres of the spine); it is not this more than of our being conscious of the psychic life of some other person or creature than ourselves. But the real question is: are these processes, themselves, attended by correspondent psychic states? That such states, if they exist, do not form a part of our personality, in those cases where their corresponding neural activities are momentarily shut-off from meddling with our cortical activities, should be no more surprising than that the conscious states of another man's brain do not mix in our personality, his brain being shut off from the risk of ignoring the evolutionary influences of "mind" throughout the major bulk of our nervous system, and of introducing false and misleading analogies along the whole line of Comparative Biology. For Neurologist, Physiologist and Biologist, then, to fall into the habit of considering neural processes generally as "unconscious" is nearly certain to end in their losing sight of the problem of mind altogether. How important is the rôle of "mind," even though one adopt, strictly, the doctrine Parallelism, I have all too scantily outlined in this paper. And in view of this I now sincerely trust that the evils, which I here emphasize as natural to false notions of unconscious processes, may not seem exaggerated.

Turning from false paths to true ones, we are finally brought to consider, in a few brief words, those lines of investigation which promise a sure advance upon our desired goal. It is a prevailing sentiment among modern scientists, that the fundamental relation of mind to body lies, at present, beyond the limits of profitable investigation. We are led in this paper to think otherwise. We are not likely to solve the whole problem in a leap, yet unmistakeably the time has come when we may enlarge our conceptions of it widely, both within the fields of Biology and of Psychology; and may do this without abanding any of the ususal severities of Science.

In our summary we reduced our general problem to eight remaining possibilites, among which we are unable to choose at present. This number immediately reduces to four upon reaching a decision upon the Weismann-Lamarck Controversy; and no one conceives that this decision lies beyond profitable inquiry, or doubts that it will soon be reached. The remaining four uncertainties will be reduced to two by determining whether end-organ processes are "immediate," or complex; and

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our brain. And, finally, in those cases where such subcortical activities do reach-up to influence the cortex, there is reason to assume that, then, their correspondent consciousness does form a part of our personality. It would appear, then, that to determine if our subcortical processes are "conscious" or not, we must be driven back upon the same grounds as for deciding whether any separate animal is conscious. And all simple and direct tests, must, therefore be henceforth abandoned, if great resultant harm from false conclusions, throughout Science, is to be avoided.

thus, again, is a practical region of investigation. Already there is enlivened interest in the subject, and results of great value are being reached along the whole line of our several senses; results which, indeed, as a good number of eminent scientists are likely to claim, leave no doubt, even now, as to how we should decide regarding this region of our perplexity. Should this happy consummation be reached, we should then have but our two primary propositions to decide between. And here, also, we have not only a legitimate field, but one regarding which it is probable the world of Science already has abundant data to give substantial conclusions, when once its importance is appreciated. In truth I have not, from the first, lost sight of or neglected the great value of the work done and being done in the field of Comparative Sense Organs; nor have I thought so much of the task being insurmountable, of determining whether all our senses date from the beginning or not, as of the problem being too grave and far reaching for me to seem to treat it either lightly, or dogmatically within the short space I have been able, here, to devote to it.

It seems, therefore that our categories of doubt are likely to narrow to a substantial conclusion, even if the present aspect of Evolutionary Science should in no way broaden. But here, again, our problem is bright with promise; for its horizon is sure to broaden. And in setting down how this is likely to happen, I beg that my few concluding words, because of the importance of the subject, may be given special emphasis. However, natural the explanation may be, it still remains significantly true that the modern Science of Biology, wonderful as it is, has yet hardly progressed beyond the bare facts of Comparative Anatomy. These have been set up, like milestones, showing us *where* the course of Animal Morphology has run. But the *Physiological* processes, explaining *how* the course was run, remain nearly as unknown, and as little considered as before the day of Darwin. That Biologic Evolution can never be an *understood* fact until these physiological processes are given due study, is, among Scientists of first rank, just beginning to be appreciated. When fully appreciated as, it will soon be in the coming century, a more wonderful period of Evolutionary Science will then open, than even that which has made this 19th Century conspicuous. And when these physiological processes do thus become the object of enthusiastic research, at that moment will the rôle of "mind" begin duly, and necessarily to receive preponderating attention. This will happen the same, whether Parallelism remain the popular doctrine or not. *Conduct* is sure to be recognized, in time, as the major region of Physiological Biology; and "mind" is the chief source of conduct, whether the word imply "molecular activities or "psychic force."

This, then, in one word, is the summary of all our conclusions. Mind would not be mind save for its marvelous complexity. The basis of this cmplexity is the variety of its sensory elements. These elements, or their physical equivalents, then, must be major factors of animal evolution; they must explain the origin of mind; and they must play in Biology and Physiology all the part that mind unquestionably plays. To neglect them hereafter, either in Biology or in Psychology, is to neglect a major factor, and probably *the* major factor of both Sciences.

FOSSILS AND FOSSILIZATION.

By L. P. Gratacap.

III.

(*Continued from Vol. XXX, p. 1003.*)

Two very remarkable and instructive deposits of vertebrate remains which illustrate their placement, sepulture, and mineralization, are represented in the tertiary beds of the Niobrara River in Nebraska, the lacustrine basins of Wyoming, in the United States, and the fluviatile plains of Argentina and Uruguay in South America formed by the water-ways which preceded and defined the present Parana, Paraguay, Uruguay and La Plata Rivers. In South America the Parana, Paraguay and Uruguay Rivers carry down vast amounts of sand, clay and detritus from the eroded mountain chains of Brazil. And this is due to the fact, as pointed out by J. Ball (Notes of a Naturalist) that a continuous and heavy rainfall in Brazil not only aids in the process of disintegration of the rock, but supplies the necessary vehicle for transporting it away. The annual rainfall in Brazil varies from 100 to 130 inches, and as its eastern seaboard is its oldest surface, this region has been "subjected throughout vast periods of geological time to the utmost force of disintegrating agencies, applied to a rock very liable to yield to them, and where, without reckoning the large proportion which must have been carried by rivers to the sea, we see such vast deposits of the disintegrated materials formed out of the same matrix." The lofty maritime ranges of Brazil have been reduced by this constant withdrawal of their materials, and the predecessor of the present river system which had its inception in those early ages afforded the conduits by which the vast quantity of detrital matter was borne down over the broad pampas and plains of Argentina and Uruguay. We may conceive that this weathering and deposition were carried on with greater energy at a time when meteorological disturbances were more violent, and when these same streams, represented in that distant time by much shorter rivers, had a steeper slope, ran more swiftly, and possessed greater erosive or tearing and sweeping power. This discharge of abraded matter has built up the wide level country which now constitutes the flat lands of Argentina and Uruguay, whose extensive pampas arose through this sedimentation continued through ages of this current of abrasion. In turn the rivers ploughing new channels through the vast accumulations over which they were now compelled to make their way, continually added to the outskirts of the new formation, and with every increment extended their own banks, and gradually assumed their present proportions and their present course. For, to use the language of Prof. Ball, "it cannot be doubted that the finer constituents carried down by the Parana and its tributary, the Paraguay, from the same original home, have largely contributed to the formation of the Argentine pampas, and Paraguay, including the northern portion of the Gran-

Chaco. Borings and chemical analysis of the soil may hereafter give us reliable data ; but in the meantime we may safely reckon that an area of 200,000 square miles has been mainly formed from the materials derived from the ancient mountains."

In the west, in Wyoming, Nebraska, and Montana, there existed in tertiary times large fresh-water lakes,[1] the successors to the wide cretaceous seas which before that era swept over the axis of the scarcely emergent Rocky Mountains. Into them, from the erosion of the non-resisting strata of their margins and encircling ridges—an erosion caused by heavy rainfalls which appear at times to have acquired the strength and permanency of the precipitation in the tropical rain areas—was washed enormous quantities of shore sand and continental mud and silt. These contributions of earthy matter in conjunction with the organic testaceous life of the lakes were finally consolidated into deposits of shales, marls and earthy limestones. Into the wide bosom of these contiguous and more or less connected sheets of inland water was also gathered the remains of a remarkable fauna, wherein, as Dr. Newberry remarks, we have the proof " that during unnumbered ages this portion of the continent exhibited a diversified and beautiful surface, which sustained a luxuriant growth of vegetation and an amount of animal life far in excess of what it has done in modern times." The fossilization of these mammals (Carnivora, Insectivora, Ruminantia, Pachyderma, Rodentia) is a matter of considerable interest. They must have been introduced into the lakes by sudden meteorological emergencies when their own capture and imprisonment in these seas was synchronous with violent terrestrial denudation by which they were safely entombed. Their own character and that of the associated flora forbid the supposition, advanced by Lyell and apparently applied by Hayden, as to their having fallen into the waters through breaking ice, over whose precarious sur-

[1] It must be remembered, however, as Dr. Hayden indicated, that " the lowest beds of the Tertiary exhibit a somewhat brackish or estuarine character, and a few fossils (*Ostrea subtrigonalis*) are found which are peculiar to such waters." Preface to Leidy's Extinct Mammalian Fauna.

face they were passing. The year was then one of sub-tropical mildness and warmth. Their excellent preservation in many instances, as well as the number and completeness of their skeletons, prove that their fossilization resulted from a sudden calamity and rapidly ensuing sepulture. It seems most likely that the floors of those ancient lakes were themselves abysses of mud, a soft calcareous and argillaceous silt into which the great mammals sank when dead, or if caught in overwhelming floods were speedily enveloped in the accompanying torrents of earthy material. These remains have undergone a partial mineralization, and have been penetrated by the mineral matrix quite extensively. In examining the typical collection of mammalian fossils from the White River of Dakota, from which Dr. Leidy made many of his species, I have observed the process of fossilization. The marrow cores of the leg-bones of *Oreodon culbertsonii* Leidy are almost closed with chalcedony quartz and calcite. The brain cavities of the same animal are filled with an exact mould of marl which indicates the pasty consistency of the original substance in which the skull was placed. The remarkable series of similar moulds used by Prof. Marsh (Monograph of Dinocerata) to illustrate the growth and specialization of the animal brain have been formed in the same way, retaining with fidelity the furrows and rugose character of the interior surfaces of the skull.[2] The interparietal spaces of the lower jaws of *Hyracodon nebracensis* Leidy are also invaded by clay and mineral matter, so as to partially mineralize the contiguous bone. In the leg-cores of the same animal a cement of argillaceous limestone with separated grains of quartz and sometimes a solid stem of quartz filling the passages are noticeable. The bones of *Menodus proutii* Leidy are heavy from parietal petrifaction and replacement, and in some the cellular structure of the bone is saturated with chalcedony flakes and granules. It is quite certain that the geological changes which have effected the elevation of these tertiary lakes and made them dry basins, bringing with them a train of mineralogical accidents as a necessary accompaniment in the percolation of mineral waters and the solidification of the natural cement which surrounds the fossils have contributed towards rendering these remains impenetrable. I do not know how the petrifaction of bone compares with the silification of wood, either as a process or in the time required, but it is certain that, in some instances, teeth have been completely changed into a mineral, as in the case of the saurian teeth found by Mr. C. M. Wheatley in a bone bed at Phœnixville, Pa. Here, to quote Mr. Wheatley's own words, "*the casts* only of the teeth remain, the substance of the tooth being converted into *dolomite*, but retaining the exact form of the tooth with the sulcations as distinct as in the original. Twenty teeth, of probably three or four genera of Saurians, *all converted into dolomite* occur on a piece of sandstone six by three inches."

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[2] These brain moulds might not be strictly considered fossils, but they come within the application of our definition as an "indication of life" in the same way as casts of shells.

Bischof, quoting the results of Marcel de Serres and L. Figuier, says that the chemical changes involved in the petrifaction of bones consist principally in a diminishment of the organic matter, in an entire disappearance of the phosphoric acid, and in an increase of the carbonate of lime and iron oxide.

Again, Fremy found that the animal substance of bones—the so-called *ossein*—was decomposed by burial and replaced by various incrusting minerals, namely, silica, sulphate of lime, fluoride of lime, and especially carbonate of lime.

Dr. Mantell has made some interesting observations on the mineralization of bones. He remarks (Petrifactions and their Teachings) of the bones of reptiles that "the osseous carapaces and plastrons of the turtles, and the bones and teeth of the crocodiles and lizards, are almost without exception heavy, and of various shades of brown or umber, from the permeation of their structures by solutions of carbonates or oxides of iron." Mantell refers to the curious appearance of bones imbedded in white limestone, which have become a blue-black from the combination of their phosphoric acid with iron, forming the blue phosphate of iron (vivianite), while in other cases the open surfaces and cells are infiltrated with calc-spar or refulgent with a golden frost of iron pyrites.

It is rare to find fossil bones silicified, and this replacement so common in vegetable or invertebrate remains is very uncommon. The bones of vertebrates are often found distorted from having undergone softening from their partial maceration in water, and become almost unrecognizable upon their extraction.

"The Maidstone Iguanodon," says Mantell, "is a striking example of this kind; in the entire series of bones exposed, there is scarcely one that is not more or less altered by compression. The humerus and thigh-bones especially are completely distorted; the vertebrate pressed almost flat, or squeezed into abnormal shapes, etc." Bones of the Moa, taken out at North Island, New Zealand, were of the consistency of putty, and could be broken or kneaded almost like columns of clay, but hardened upon exposure and drying.

In this connection, relative to the accumulation of bone deposits in the past, some observations of the recent African traveller, J. W. Gregory, are of vital interest. He says (The Great Rift Valley, J. W. Gregory, p. 268) "here and there around a water hole we found acres of ground white with the bones of rhinoceros and zebra, gazelle and antelope, jackal and hyena, and among them we once observed the remains of a lion. All the bones of the skeletons were there, and they were fresh and ungnawed. The explanation is simple. The year before there had been a drought, which had cleared both game and people from the district. Those which did not migrate crowded round the dwindling pools and fought for the last drop of water. These accumulations of bones were therefore due to a drought and not to a deluge."

The fossilized remains of marine vertebrates are not uncommon, and in the cretaceous beds of Wyoming they have been preserved with remarkable completeness, eliciting the remark from Prof. Marsh that "he noticed the skeletons of six of those mighty swimming lizards—the mosasaurs—each eighty feet in length, in sight at one time."

The fish beds at Twin Creek, Wyoming, the fish remains in Ohio, including the great Dinicthys, those at Sunderland, Mass., together with numerous indications of marine creatures in the Cretaceous of New Jersey and the phosphate deposits of the Ashley River, S. C., seem to show that somewhat more favorable conditions for their preservation existed in these earlier times than at present, when bones appear to become quickly destroyed in the ocean, and only the most refractory substances, as enamel and very dense bone, resist the agencies of solution. It seems altogether likely that the sedimentation must, at least at seasons or periods, have been rapid and considerable; that vast volumes of calcareous mud discharged into the cretaceous seas entrapped fish and reptile within the unchanging films and sheets of earthy matter. The wonderfully preserved fish of the eocene in the Green River beds, exhibit instances of almost complete immobility, as if no motion had disturbed the fish since its death, no tide or current, and that it was quickly covered over by sediment. The fish and reptilian remains in Ohio, Illinois, Pennsylvania, Iowa and Missouri bear evidence of separation and rolling, the articulations being infrequently retained in place, the mouth parts and skulls alone cohering together, though these are more commonly dismembered, while in complete uniformity with the experience of to-day, in many cases, teeth and spines are the sole representatives of these ancient denizens of the sea. Mechanical conditions under which marine vertebrate remains have been entombed very naturally affects the nature of their preservation. The sandy, coarse shore deposits which prevailed in the Catskill period—our equivalent of the Old Red Sandstone of Europe—was unfavorable for the cohesion of the fish which were enclosed in it, and the action of shore waves and the agitation of the gravelly matrix broke them apart, and scattered over the shore surface the fragments of bones, scales and spines. On the other hand, the shallow sea basins wherein the Huron and Erie (now shown by Prof. Orton to be identical) shales were deposited, furnished a fine-grained impalpable carbonaceous silt in which occasionally the remains of the monstrous placoderm Dinicthys were entombed entire, and preserved with comparatively slight dislocation or injury. In the open sea of the Upper Helderberg and Carboniferous where conditions similar to our present seas may have prevailed, little else than the hardest portions of the fish were preserved as the dermal tubercles, spines and armored heads, with an occasional jaw retaining its teeth. Even this slender survival of material compares favorably with the destructive activity of our seas, and may perhaps add weight to the opinion of Verrill and Smith that this destruction to-day can be only assigned to the depredations of small crustacea. It also lends some seriousness to suspicions that in these paleeozoic waters deposition was more rapid than at present. But in the fish layers of Boonton, N. J. and Sunderland, Mass., in the Triassic slates and in the thinly fissile lime shale of Twin Creek, Wyoming, we find an extensive placement of fish skeletons and bodies which are usually quite perfect in outline and which must have been deposited almost simultaneously by some sudden catastrophe, and also very rapidly sealed within fresh sediment, in which they remained undisturbed by the motion of the water, and protected against change by the overlying films of calcareous mud. Dr. Newberry has suggested that in the case of the triassic fish their death was connected with the irruption of hot waters produced by the intrusion of the igneous trap rocks through the floor of the triassic sea. The similar beds at Weehawken, N. J., show that the fish have undergone considerable maceration and distortion, and the subsequent breaking of these slates have helped to obliterate the organic remains. The Twin Creek fish bed is a compilation of very thin sheets of flaky limestone with clay, between whose slightly undulating surfaces runs a waving black film, the section of a slab presenting a delicately lined face like a paper pencilled with parallel tracings. Here the fish lie with very slight dislocation appearing; to use Dr. Leidy's words, "as if whole shoals had been suddenly enshrined for the contemplation of future ages." It would seem as if an innumerable series of overflows, each carrying with it floculent carbonaceous matter, had left a deposit of carbonate of lime from suspended particles over the fish, and, as each overflow receded, these fine particles followed the absorbed water and remained upon the surface in a veil of black sediment. It may be that a sudden irruption of water carrying suspended mud may have overwhelmed these fish, and this water-burst may have been attendant upon other circumstances by which the fish were frightened into shoals and exposed to a common death. The carbonaceous films may also be due to the penetration of oil between the laminæ of limestone, the oil arising from the decomposition of fish.

Some of the bone beds of Ohio present a mass of ground plates, broken teeth and crushed spines, which have become cemented together by carbonate of lime into a breccia of organic fragments. They represent, according to Dr. Newberry, a deposit in deep water of the excrements of larger fish whose digestive vigor has failed to entirely destroy the harder parts of their prey. It is not necessary to assume that these remains were buried very quickly, as their own strength and hardness would resist erosion, solution and the destructive power of animal feeders, though the circumstances attending its deposit must have been peculiar. A fragmentary layer of such a character accumulated in deep water—this conclusion Prof. Newberry believes is warranted on account of the absence of shore stones, gravel, pond wash, etc.—and not dispersed by the currents, and quite destitute of all other fossils than fish debris, is an anomaly which Prof. Newberry explains by this assumption: "It has seemed to me not impossible that this fish bed was, for the most part, made up of excrementitious matter, and that it represents the hard and indigestible parts of fishes which have served as food for other and larger kinds. On this supposition the fragmentary and worn appearance of the bones would be attributable to the crushing, maceration and partial digestion which they have suffered. If this is the true history of the deposits, it accumulated in some nook or bay, perhaps bordering a coral reef, where large and small fishes congregated, age after age, until their kjokkenmöddings formed a sheet some inches in thickness over all the sea-bottom."

It may, however, be said that the strongly bituminous or oil odor in this rock elicited upon striking it, shows that it did not represent solely the excrements of fish, but received very probably the occasional contribution of the bodies of living members of the surrounding marine fauna. In this connection the important observation recorded in Lyell's Principles (Vol. II, p. 583), that upon the north coast of Ireland—the Rockhall Bank—"a bed of fish bones was observed extending for two miles along the bottom of the sea in ten and ninety fathoms of water," is of interest. Lyell, in the same place, also speaks of fish bones occurring in extraordinary profusion eastward of the Faroe Islands. This "bone bed" was three miles and a half in length and forty-five fathoms under water, and contained a few shells intermingled with the bones.

In the cranial plates of *Acanthaspis pustulosus,* one of the fishes of the Devonian of Ohio, the space between the outer hard bony walls are filled with carbonate of lime which has infiltrated and consolidated the intra-mural cellular tissue, while the clavicle of *Onychodus sigmoides* presents internally a granulated area of carbonate of lime similarly formed and Prof. Claypole speaks of the second layer of the shield of his placoderm fish from the Upper Silurian of Pennsylvania as having its cells "filled with infiltrated calcareous matter which, under the action of the weather, is dissolved out, leaving an exceedingly brittle cellular mass to represent the original shield". These bones probably retain their phosphate of lime, since fish bones and teeth in the Old Red Sandstone in Lievland (?) according to Bischoff, have lost but very little of the original percentage of this salt.

It must, however, be remembered that normal calcium phosphate is soluble in ammoniacal salts, sodium nitrate, common salt and other salts; that its abstraction from buried bone may be quite rapid, and the cavities left by its absorption may become filled with mineral matter. An exchange may be effected between carbonates of alkalies and the phosphates in bone by which carbonate of lime remains and the phosphoric acid is removed, and solution may be effected by aqueous carbonic acid alone. The turtles of the Miocene of Nebraska, which are so numerous, are represented by their joined carapaces and plastrons, and these are filled with the porous marl or earthy limestone of the White River beds. The bone of these parts presents a finely reticulated structure, and through its minute passages a ferruginous infiltration appears, giving it a speckled surface. It seems more than likely that much of the original phosphate has disappeared, and that carbonate of lime with argillaceous admixture composes the present skeleton.

The fish of the Twin Creek, Wyoming basin have each been immersed in the products of its own decomposition. Their bones seem to be, in many instances, covered by an integument formed from the dried and mineralized skin and scales of the living fish, while the oily elements arising from their dry distillation or decomposition have impregnated the bones, converting them to a dark honey-brown substance somewhat laminar in structure, in places, elsewhere irregularly cubical, and soft and brittle. The fish in the triassic shales present ichthic outlines made up of rhomboidal scales. These scales, as is well-known, are essentially bone, very smooth, hard and lustrous, their shining and durable surface being formed of a substance allied to enamel and now called *ganoin.* This ganoin has undergone little or no change. The scales yield slowly to hydrochloric acid. The original cartilaginous or fleshy parts have probably aided preservation by forming oily products which bathed the fish, enclosed as it was in the shale, and upon dessication contributed their indestructible carbonaceous residues to its mass.

The cretaceous saurians entombed in the gypsiferous shales and limestones of Kansas have successfully escaped the action of decay, while the remains of sharks, predaceous fish, and tortoises are also found as fossils, but only in a partial phase, at least, of preservation. The bones of the fish, who were, according to Cope, related to the salmon, possess such a density and hardness that they are maintained as nuclei crowning knobs of shale, which stand in relief amidst the worn and denuded surfaces about them. This is quite remarkable, and seems to clash completely with what we know to-day of the preservation, or rather absence of preservation, of the bones of marine vertebrates. Prof. Marsh, in speaking of the specimens of cretaceous birds, remarks that "that they are all *mineralized* and in the same state of preservation as the bones of the extinct reptiles which occur with them in these deposits."

In the process of mineralization, which is the last phase of the entire process of fossilization, we may imagine that bones undergo contrasted changes, according to the varying circumstances of their position. Prof. Leidy has even observed in a letter to Dr. Holmes that fossilization, petrifaction or lapidification is no positive indication of the relative age of organic remains. The cabinet of the Academy of Natural Sciences of Philadelphia contains bones of the megalonyx and of the extinct peccary, that are entirely unchanged: not a particle of gelatine has been lost, nor a particle of mineral matter added, and, indeed, some of the bones of the former even have portions of articular cartilage and tendinous attachments well-preserved. On the other hand, bones of mammals from the Keuperkalk near Schweinfurt, Germany, yielded to Von Bibra scarcely a trace of phosphoric acid (Bischof); the principal constituent was clay. Bones exposed to saturation by water which may, or must, contain a very considerable quantity of mineral salts in solution, soon surrender their soluble elements and undergo a gradual reconstruction amounting, in some cases, to complete lithification. The phosphate and carbonate of lime may be replaced by silica, or the former may be expelled by reaction with alkaline carbonates, and the bone assume more and more entirely the composition of carbonate of lime.

The circumstances attendant upon the fossilization of invertebrates necessarily contrasts strongly with those observed in the fossilization of vertebrates. Invertebrates—corals, mollus, crustacea—are more usually the inhabitants of the salt waters, they are sedentary or somewhat limited in the range of their voluntary wanderings, their hard parts are almost entirely carbonate of lime, and at their death their shells or coverings are apt to be so situated as to secure more or less perfect preservation. The invertebrates which form the largest part of the fossil remains of the world are shore occupants, or, if removed from land, were living in comparatively shallow waters, waters certainly not exceeding 500 fathoms in depth. They lived either in the sandy flats or rocky barriers along the very margins of the ancient ocean and upon the oscillating edges of the continent, or in the impalpable sediment deposited further away from the shore, or gathered in estuarine inlets, or they formed the denizens of purer and deeper waters and became later, in the secular changes of the earth's crust, consolidated into limestone beds. This variation of position implied a greater or less likelihood of preservation as fossils.

Darwin has observed that along the west coast of South America " no record of several successive and peculiar marine faunas will probably be preserved to a distant age." And the reason he assigns is that as the coast of that continent is rising, " the littoral and sub-littoral deposits are continually worn away, as soon as they are brought up by the slow and gradual rising of the land within the grinding action of the coast-waves." The remains of animals so situated as to become exposed to the reassorting action and denudation of the shore currents and waves may suffer pulverization and dispersal, and those which are not soon covered by sediment may be dissolved or injured. Those farther away are entombed in the accumulation of sediment which falls down over the sea-floor more uninterruptedly at some distance from land where it is less agitated and shifted by the waves and currents. In the elevation of the ocean bottom and its gradual change to dry land the emergent surfaces would undergo considerable disturbance from the waves, and along these eroded edges the fossils would disappear by crushing and attrition. Yet Darwin's observation seems scarcely so important, when we consider that the same stratum continued outward upon the sloping bed of the ocean is for some time exempt from this wearing, and during that time the sediments produced by the destruction of its own emergent portions are constantly accumulating over it and rendering its own stability greater. This view has been indeed taken by Mr. Hopkins, who expressed his belief that sedimentary beds of considerable horizontal extent have rarely been completely destroyed. Furthermore, we must remember that, in so far as we have indicated three different cycles of deposition with their accompanying and characteristic forms of life, these animal forms are not restricted with any precision to these areas, and that organic remains which, by some accident, have been destroyed upon one kind of bottom, may remain represented in another that was not subject to the same exigencies. As Prof. Verrill remarks, at the end of an enumeration of six or seven sorts of bottoms which carried distinctive faunas: "It must, however, be constantly borne in mind that very few kinds of animals are strictly confined to any one of these subdivisions, and that the majority are found in two, three or more of them, and often in equal abundance in several, though each species generally *prefers* one particular kind of locality. In other cases the habits vary at different seasons of the year, or at different hours of the day and night, and such species may be found in different situations according to the times when they are sought."

The animals living along rocky shores and clinging to the rocks themselves or dwelling in their crevices and amongst the sea-weeds that clothe them, are not so apt to be preserved as fossils, except as they die they are swept seaward and become buried in the muds or sands of the less exposed beaches and flats. The occupants of the sandy beaches are provided with organs and have developed habits which enable them to secure protection against the wear and violence of the waves and the alternating drying and wetting of the district they inhabit. They penetrate the sand deeply and secure immunity from the accidents of the surface in the pockets, burrows and tubes within which they can withdraw themselves. These protective habits render their preservation as fossils much more probable. The animals living in the muddy bottoms, whereon we may suppose a finer deposit settles, forming a tenacious and impalpable sediment or silt, are, in many cases, identical with those placed within the sandy areas, and immediately along the shores of a country the sandy and mud types of beach grade insensibly into each other so that a sandy beach can hardly be free from mud or a muddy margin of the land free from sand. And in this way the animal species found on one or the other accommodate themselves freely and easily to the vicissitudes and qualities of both. But the character of a mud bottom insures a better preservation of a shell as a fossil, and many fragile and delicate organisms, such as the fossil hydrozoans, known as graptolites, are retained in the fine-grained slates (which have originally been mud layers) that would have scarcely survived comparison in the coarser and impressionable beds of sand. Such muddy layers may be entirely argillaceous or markedly siliceous, or they may be calcareous and formed at considerable depths, as in the case of the deep-sea ooze which assumes the character, as described by Sir C. Wyville Thompson, of a grayish, calcareous paste. These beds from this fine state of mechanical division are precisely adapted for keeping unbroken the tests, coverings and hard parts of the animals that are buried in them, and if sufficiently argillaceous to prevent crystallization, upon consolidating into stony strata retain their contents in a very beautiful and perfect condition.

The deeper zones of the sea nurture the coral growths, or receive from the pelagic life above them the unceasing contributions of dead shells, the cases of foraminifera, and the skeletons of aberrant crustacea, or form beds congenial to glassy sponges, submarine thickets of crinoids and fields of gorgonias. These sea-deposits, which are somewhat exempt from the mingling sediments of the shore, though, of course, only approximately, and more or less completely, according to the nature and distance of the neighboring coasts, as regards their fossiliferous character, form very perfect beds of deposition. The variety of animal life becomes here very great, and its fertility continually augments the rising sheets of animal precipitation. The pelagic life above these regions is constantly contributing its mineral contents to these beds, and the broken, half-dissolved shells of pteropods, with the tests and insoluble residue of foraminifera, form a calcareous commixture, in which whole shells, corals, crinoids, star-fishes, sea-urchins and the dust raining down from dead and decomposed swimming organisms, parts of fish, etc., become imbedded. The explorations of the Challenger showed that, according to Murray, the foraminifera of the open sea are subjected to solution in the carbonated sea-water, and that their argillaceous *ash*, so to speak, drops down and spreads upon the floor of the ocean basin as a red or gray clay, while in places the siliceous parts of radiolarians also furnish a very considerable proportion of this mineral sediment, and the mass holding carbonic acid in solution has doubtless a solvent influence on many of the contained testaceous remains, and destroys their perfection as fossils. Upon elevation and consolidation into stony layers, the process of crystallization, started in the calcareous paste or jelly—which process partakes also of the nature of a hardening in a natural cement—produces sometimes a cementation of the parts, so that the fossils are coherent throughout with their matrix, and are extracted with difficulty, or, indeed, but obscurely detected at all. Centers of crystallization also form in the centers of the fossils themselves, by which all trace of organic structure is obliterated.

One of the most typical and important groups of fossils is the corals, and to discover the circumstances of their accumulation in the past we must look at the coral making portions of our globe to-day. Many of the deep sea corals are simple or single individuals, and are living in neighborhoods in the deep seas, while the great reef-making corals rising in coral banks to the surface of the water and prolonged by branching or acervuline growths are communal, and these coral colonies form the substantial basis of sea islands. They furnish the material which is heaped up in calcareous sand strata, making porous limestones, such as are seen in the Aeolian rocks of the Bermudas, or which, dissolved as a calcareous glue, unites the agglomerated fragments of beach shells into the Coquina beds of Florida. The coral colonies begin their growth at depths hardly exceeding 50 fathoms, though the Challenger explorations revealed coral life at depths of 1,300 fathoms. If they establish themselves in more shallow water at the customarily assumed limit of 20 fathoms, the sinking of the shores they skirt, according to the convenient hypothesis of Darwin and Dana, depresses the platforms from which they start to this depth or much more. The thermal conditions probably determine the depths at which reef-building corals can live, and it is a possible and probable circumstance that in varying positions and in other geological times, reef-making corals may have begun their labors at depths much exceeding 20 or even 50 fathoms. The coral wall rises upward, and it bears in its midst and over its surface an extensive and variegated ocean life. First the corals of different genera massed together in contiguous groups and colums, then the fan corals (gorgonias) with *bryozoa, crinoids,* coralline sea-weeds and sponges, and finally numerous sea-worms (annelids) like *Serpula* complete the heterogeneous assemblage with an occasional mollusc or some sedentary crustacean. "All these things," to quote the expressive description of Thompson, "living and dying, are constantly yielding a fine powder of lime, which sinks down and compacts in the spaces among their roots; and every breaker of the eternal surf grinds down more material and packs it into every hollow and crevice capable of receiving and retaining it." In this dust the dying portions of the coral wall become entombed, and mingling with them the shattered or complete skeletons and remains of the associated fauna. Thus the whole is ready for fossilization; it is raised, or similar beds were raised, above the action of the ocean waves, becoming more and more bound together, more and more hardened and more dense. The solvent action of surface waters cement it together and converge through the interstices of the mass molecules of carbonate of lime which fill up the minute crevices, the microscopic pores, hastening the formation of a fossiliferous limestone. In these perfectly preserved masses, heads and nodules of coral are found retaining the most delicate details of structure, and with them fragments or complete examples of their associated guests and tenants. One of the most striking illustrations of an ancient fossil coral reef is that offered by the Falls of the Ohio at Louisville, Ky., where ledges of horizontal limestone form a low escarpment over which the river plunges. The formation is Devonian, and, while the softer parts of the stone have weathered away, the harder calcareous corals stand out in projecting groups, and in their commingled diversity of genera with bryozoal remains and the joints, stems and heads of crinoids, forms a complete reproduction of a modern coral reef. As to the condition of preservation in which the corals are found, Lyell has taken occasion to call attention, in the collection of Dr. Clapp,[3] to the equal perfection of the "pores, foramina and minute microscopic structure" of the palaeozoic corals with those gathered from our present oceans, remarking that "no one but a zoologist would have been able to guess which set were of modern, and which of ancient, origin."

We may feel quite confident that in any study of our fossil-bearing strata we are generally contemplating beds that have not been abyssal in their origin. The remains of mollusca in the abundance usually present in our fossiliferous beds, cannot easily be regarded as indicative of very great depths of deposition. The Challenger expedition, while it revealed an unexpected fertility in the deep-sea life, also showed that molluscan life at great depths was scanty and unimportant. Sir C. Wyville Thompson summarizes the conclusions reached by saying that "the two great modern groups of the mollusca, the Lamellibranchiata and the Gastropoda, do not enter largely into the fauna of the deep sea. Species of both groups, usually small and apparently stunted, were widely, though sparsely, diffused." The character of many of the fossiliferous beds betrays readily enough the bathymetric relations they bore to the continent. The sandy grits, coarse conglomerate, the shales and slates, modified by the calcareous debris of shells and the argillaceous marls, are not deep-sea products. The pure limestones themselves cannot be regarded as having been formed at excessive depths since so much of the ancient life preserved in their fossils is irreconcilable with this view. Prof. A. Agassiz has indeed written (Dredgings of Three Cruises of the Blake): "Probably no invertebrates of a period older than the jura and chalk existed in the deep sea, or, if they did exist, they did not wander far from the continental shelf. Their distribution was then as to-day, mainly a question of food. The animals of those times lived upon the shelf, and, while they and their predecessors remained as fossils in the littoral beds of the earlier formations, their successors, belonging either to the same or to allied genera, passed over into the following period."

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[3] **Second Visit to the United States: Sir Chas. Lyell.**

(*To be continued.*)

THE BACTERIAL DISEASES OF PLANTS: A CRITICAL REVIEW OF THE PRESENT STATE OF OUR KNOWLEDGE.

BY ERWIN F. SMITH.

(*Continued from Vol. XXX, p. 924.*)

V.

II. THE HYACINTH (HYACINTHUS ORIENTALIS L.).

2. THE BACTERIOSIS OF HYACINTHS (1889).

(I) THE DISEASE:

(1) *Author, Title of Paper, Place of Publication, etc.*—This disease was described by Dr. A. Heinz, Director of the Botanical-Physiological Institut in Agram. His paper (**35**) Zur Kentniss der Rotzkrankheiten der Pflanzen was published in *Centralblatt f. Bakt. u. Parasitenkunde*, Bd. V, No. 16, 12 April, 1889, pp. 535–539.

(2) *Geographical Distribution.*—The disease was discovered in some potted hyacinths received from a florist in Agram. There is no statement respecting its occurrence in the field or in hothouses.

(3) *Symptoms.*—All of the potted plants developed equally well until blossoming time, the last of January. Then visible differences appeared, although the plants were exposed to the same external conditions. Some of the plants continued their normal development, unfolded their blossoms in regular order, and remained entirely sound. Others were delayed in their development, and several circumstances indicated the presence of a disease before there were unmistakable symptoms. These symptoms soon appeared. The tips of the leaves yellowed, shriveled, and dried out for a distance of some centimeters. The blossoms either fell off before unfolding or opened in irregular order, and fell off soon after. Finally, in all the diseased specimens a progressive rotting was detected. This first attacked the axes of inflorescence, and then the leaves and bulb

scales. This rot produced a viscous (schmierigem), bad smelling slime. After two or three days the bulbs were entirely softened, and only the slightest pull was necessary to draw the leaves and scapes out of the bulb scales.

(4) *Pathological Histology.*—A microscopic examination of the slime and of the affected tissues showed the existence of great numbers of bacteria. Primarily, they occupied the intercellular spaces; but the dead cells and the vessels were also full of them. The nucleus of the cell resisted longest, and could still be detected after the rest of the protoplasm was destroyed. No Hypomyces or other fungus was present.

(5) *Direct Infection Experiments.*—No record of any.

(II) THE ORGANISM.—*Bacillus hyacinthi septicus* Heinz.

This name does not mean that Dr. Heinz regarded his organism as in any sense a variety of *B. hyacinthi* Wakker, the practice of using trinomials to designate varieties not being current in bacteriology or generally accepted as good usage in any branch of botany. Dr. Heinz simply followed a common and vicious practice in the selection of his specific name, the literature of bacteriology being full of trinomials, quadrinomials, and even more extended names. Of course, all of these polynomials, Dr. Heinz's included, must give way to binomial names, but in as much as I have not seen his organism, and as it was not fully described, I prefer to leave the consideration of its proper nomenclature to whomsoever shall have occasion to study it thoroughly.

1. *Pathogenesis:*
   (A) Yes.
   (B) Yes. Very easy. "The material may be taken from any suitable diseased spot; and it is demonstrable that everywhere the same species of bacterium is present in large quantities—I might almost say in pure culture—foreign organisms occurring only in the outer bulb scales, where they might be expected, and where they are of no consequence." "The here observed bacteria belong to a single species." "I could not discover a mixture of different bacteria; the above named is also unlike *Bacterium termo* (Cohn?). So much is

established not only by the microscopic investigation but also by the very successful culture experiments. *Bacillus butyricus* was also not to be found."

"Necessary precautions being taken for granted, a pure culture is obtained the easiest, when, by means of flamed instruments, the epidermis is lifted from a diseased but not yet entirely softened spot, a trace of the slime removed from the parenchyma, and the same transferred to a nutrient substratum. The material may be taken just as well from a bulb scale, only in this case one must set to work so much the more carefully. Whether we inoculate a liquefied substratum directly, or put a trace of the slime in sterile water, and inoculate only from this (a very simple method of dilution, which here leads to entirely satisfactory results), we always get on the plate an abundance of the uniform colonies of this bacterium."

(C) Yes. The inoculation experiments were very successful. "If, by means of a needle, an extremely small quantity of the bacilli are pricked into the epidermis of a leaf, or of a scape of an otherwise entirely sound hyacinth, the sickening of this part with the described symptoms can usually be observed within 24 hours. The most destructive action takes place around the point of inoculation, over a breadth of about 3 cm. Here at first the tissues softens, the part becoming transparent. Finally, as a rule, the organ breaks, as its tissue, including the epidermis, is changed for the specified distance into the characteristic, slimy-viscous, rotten-smelling pulp. We obtain the same result when the inoculation is made on a bulb scale. The inoculated scale first sickens, but soon after the neighboring ones also become affected, and the disease spreads from this point even into the parts above ground. The reverse behavior (inoculation of the aerial parts, and the spread of the disease into the bulb) could not be observed. This circumstance indicates, in all probability, that under natural conditions the disease spreads from the bulb upward. I would add, that the spread of the bacilli from the point of inoculation is very rapid. If a leaf 15 to 20 cm. long is inoculated at its base outside of the bulb, the bacilli may be detected even after 24 hours, at a distance of 5 to 10 cm. in the leaf parenchyma."

(D) Apparently; in part, at least. Statements not very explicit.

Conclusion.—Pathogenic nature clearly established.

Note.—Lack of full proof under D seems to be atoned for by repetitions under B and C.

2. *Morphology:*

(1) *Shape, size, etc.*—The organism is a conspicuous bacillus, with rounded ends. It is 4 to 6 x 1μ, and always single. Shorter rods occur; but direct observation shows these to be younger stages, which have resulted from division. The process of division is easily observed in hanging drops.

(2) *Capsule.*—No mention of any capsule.

(3) *Flagella.*—Organism actively motile. Nothing concerning organs of motion.

(4) *Spores.*—No mention of any spores.

(5) *Zooglœa.*—"Inoculated nutrient fluids become uniformly cloudy. I have not observed in them any local heaping-up of the bacilli."

(6) *Involution Forms.*—No mention of any involution forms.

3. *Biology:*

(1) *Stains.*—No special peculiarities. The organism colors readily with all the ordinary stains.

(2) *Gelatin.*—Organism grows well upon ordinary gelatin. The surface colonies on plate cultures are circular, about 2 mm. in diameter, smooth and shining, not very prominent, bluish-white with a somewhat darker center, translucent. The buried colonies have an oval form, and are rather (ziemlich) pointed at the poles. They are yellowish-white and dull. The bacillus does not liquefy gelatin.

(3) *Agar.*—Growth as on gelatin. There are no noteworthy differences either in plate or stab cultures. In stab cultures the bacillus grows uniformly the whole length of the stab, and

forms on the surface of the agar a smooth, bluish-white, intensely shining growth, which does not reach the wall of the tube even after weeks. After 8 to 10 days little vesciculate projections appeared along the stab.

(4) *Potato, etc.*—Organism grows well upon potato, forming after 36 hours a dirty yellow, slimy covering, the surface of which is granular. Cultures several days old sent forth an intense rotten odor.

(5) *Animal Fluids.*—No mention of specific sorts. See (II) 2 (5).

(6) *Vegetable Juices.*—No mention of any trials.

(7) *Salt Solutions and other Synthetic Media.*—The organism grows well in Cohn's nutrient solution, and in sugar solutions, etc. In sugar solutions, with addition of sodium phosphate and peptone, a fine growth, but no butyric acid.

(8) *Relation to Free Oxygen.*—Aerobic. No special experiments, but from the behavior of the agar stab cultures the bacillus is probably also facultative anaerobic.

(9) *Reducing and Oxidizing Power.*—No statement.

(10) *Fermentation Products, and other Results of Growth:*

(a) *Gas Production.*—No statement.

(b) *Formation of Acids.*—No odor of butyric acid could be detected in any of the cultures. No mention of any other acid.

(c) *Production of Alkali.*—No statement.

(d) *Formation of Pigment.*—Organism dirty yellow on potato.

(e) *Development of Odors.*—Causes a rotten smell in the host plants, and an intensely putrid odor on potato. Chemical nature of the odor not determined. No smell of butyric acid.

(f) *Enzymes.*—No statement. Cell walls are softened and destroyed, and protoplasm is consumed in the presence of this organism.

(g) *Other Products.*—No mention of any.

(11) *Effect of Dessication.*—No statement.

(12) *Thermal Relations:*

(a) *Maximum for Growth.*—Not determined.

(b) *Optimum for Growth.*—Not determined.

(c) *Minimum for Growth.*—Not determined.

(d) *Death Point.*—Not determined.

(13) *Relation to Light.*—No statement.

(14) *Vitality on Various Media.*—No statement.

(15) *Effect on Growth of Reaction of Media (acid, neutral, alkaline).*—No statement.

(16) *Sensitiveness to Antiseptics and Germicides.*—No statement.

(17) *Other Host Plants.*—The common onion, *Allium cepa*, was inoculated both in the leaves and in the bulbs, and in both cases with positive results. This plant must therefore be included as a possible host. Inoculations into other plants, such as Richardia, Chlorophytum, Triticum, Phaseolus, etc., gave negative results.

(18) *Effect upon Animals.*—No statement, and probably no experiments.

(III) ECONOMIC ASPECTS:

(1) *Losses.*—Disease not observed in the field.

(2) *Natural Methods of Infection.*—Not known.

(3) *Conditions Favoring the Spread of the Disease.*—Not known.

(4) *Methods of Prevention.*—No suggestions.

Remarks.—Organism not satisfactorily described. The first part of the paper is devoted to a brief review of papers by Wakker and Sorauer. De Toni and Trevisan in (11) Saccardo's *Sylloge*, vol. VIII, p. 984, under *B. hyacinthi* Wakker, make the following remark concerning *B. hyacinthi septicus* Heinz,—"verisimiliter huc spectat." The reason for this remark is not apparent. Certainly, so far as we can judge from the published statements of Drs. W. and H., the two organisms are widely different in their pathogenic effects, and also in their behavior on culture media. The rapid destruction of the host by Dr. Heinz's germ is specially noteworthy.

Whether the hyacinth disease described by Dr. Sorauer is distinct or identical with the preceeding, whether it is identical with the white rot of the Netherlands, or, finally, whether it is in any proper sense of the term a bacterial disease at all, must be left an open question. His account of the symptoms especially in the foliage certainly suggests the disease described by Heinz. Sorauer himself identifies it with the white rot of the hyacinth described by Schneevoogt and others, and also erroneously supposes it to be the same as the yellow disease described by Wakker. Dr. Sorauer made numerous and apparently quite careful microscopic examinations, but no pure cultures. His attemps at direct infections yielded negative results and he says that the bacteria do not attack sound well ripened bulbs under normal meteorological conditions. The fungus, *Hypomyces hyacinthi* Sorauer, was closely associated with this rot but is believed to be only a secondary trouble in as much as the bacteria were sometimes found in the affected tissues where no mycelium could be detected. The fungus may however spread the disease by acting as a carrier of the microorganisms. The latter consisted of coccus forms and rods, and were identified, in part, as *Clostridium butyricum* (*Bacillus amylobacter*), apparently on no better grounds than the microscopic appearances and a bad smell supposed to be due to butyric acid. This work was done fifteen years ago and now has little other than a historic value. The following are Dr. Sorauer's papers:

(**36**) Der weisse Rotz der Hyacinthenzwiebeln, *Deutscher Garten*, 1881, pp. 193, (not seen), and (**37**) Der weisse Rotz (Bacteriosis) der Hyacinthenzwiebeln, Sorauer, *Handbuch der Pflanzenkrankheiten*, 2nd. ed., part II, pp. 95–102, with one plate (devoted exclusively to the Hypomyces), Berlin, 1886.

Concerning the "white rot" of the Netherlands, Wakker states distinctly that it is not a parasitic disease, and seems to have proved that it does not attack sound bulbs but only such as have been weakened by a nonparasitic gummosis. Whether this is always the case may, perhaps, be regarded as doubtful, in as much as Dr. Wakker's inoculation experiments were not very numerous. This white rot is a slimy, and often foamy, stinking, bacterial decay to which gummosed bulbs are frequently subject in rainy, warm weather, particularly after the bulbs are dug and placed in silos in the earth to undergo a ripening process. The disease may also appear afterwards in rooms where the bulbs are spread out to dry. The whole or only a part of a bulb may be attacked according as the whole or only a part is gummy. The diseased parts are soft and white and look as if boiled. Dr. Wakker's views may be found in (**34**) and in (**38**) Contributions à la pathologie végétale. VI. Nouvelles recherches sur la gommose des Jacinthes et plantes analogues. *Archives néerlandaises*, T. XXIII, Haarlem, 1889, pp. 383–396, 2 plates.

In confirmation of the statements made in No. 1 of this series, p. 632, 2nd paragragh, and as a curious commentary on the way in which many books are thrown together, we may in passing refer to the account of "the white or yellow rot of hyacinth bulbs" given in Dr. Frank's new book (**39**) *Die Krankheiten der Pflanzen*, Bd. II, pp. 23–25, Breslau, 1896. Most of the two pages is wasted in an exposition and criticism of Dr. Sorauer's views; Wakker's studies are condensed into four lines and badly at that; no mention is made of Heinz's paper; and the review concludes as follows: "Für eine pathogene Bakterienwirkung fehlt wenigstens bis jetzt der Beweiss."

EDITOR'S TABLE.

We publish in our news department an account of a project now on foot in Europe for the protection of the large game of Africa. It is greatly to be hoped that this plan will be carried into effect without delay. Certain members of the French Société d'Acclimatation have formed a committee having for its object the domestication of the African elephant, which seems to be entirely feasible. Meanwhile, in America the plans for the preservation of a herd of bison are not being realized. This is due to the neglect of Congress to legislate for the proper protection of game in the Yellowstone National Park. This must be done at an early day, or the herd of bison there will be exterminated. It is expected that a portion of Fairmount Park, Philadelphia will be set apart for the breeding of bison. If this hope shall be realized and other small herds now existing are preserved, this species may be saved from extinction as a result of inbreeding. This fate is said to be overtaking the herd of Aurochsen or European bison in the government preserve in Lithuania. They are said to be becoming very infertile. The seals of Alaska are having a rest, and their destruction is for the time being delayed. Enough remain to enable them to recover their old abundance if protected. The American and British Commissions are composed of able men who will see the herd preserved if they can accomplish it. The crusade of the Audubon society against the slaughter of birds for the decoration of ladies' bonnets has produced good fruit. The practice of wearing birds has become less common in America at least, and a relatively small number of women appear to be willing that the most beautiful of living things shall be exterminated to gratify a fleeting fancy.

It is to be hoped that the recent enormous seizure of game being illegally shipped out of the State of Minnesota, over the Chicago, Milwaukee and St. Paul Railroad, will be very much of a check upon the extinction of the game mammals that has been going rapidly onward for some time. The seizure made in the freight yards of the Chicago, Milwaukee and St. Paul Railroad, at St. Paul, comprises several tons of venison, and the fines, at the rate of $50 per piece, may amount from 40,000 to 50,000 dollars.

The newspaper press is again publishing reports of the existence of the Mammoth in the interior of Alaska. Bones of this species are abundant in that region in the latest deposits, and there is no *a priori* impossibility in the supposition that some herds of this gigantic mammal still survive. On the other hand, the sole source of the stories are the aborgines, who, as we are informed, are not noted for veracity, and who like to be entertaining. The huge bones have not escaped their observation, and may have given rise to the stories that they tell, The matter is, however, worth looking into by persons who have opportunities for doing so on the spot.

How differently different people regard nearly the same subject may be illustrated by the people of Massachusetts struggling hard for the last five or six years to exterminate the gypsy moth and by the action of the Entomological Society of London in appointing a committee to take measures for the protection of British lepidoptera from extermination at its meeting on October 14. Warm sympathy with the movement has been expressed by the London Entomological and Natural History Society the North London Natural History Society, and the Liecester Literary and Philosophical Society. The first step to be taken is to learn what species are in danger of extermination.—F. C. K.

The Field Museum of Chicago has been recently enriched by an extremely valuable callection of Egyptian Antiquities, through the generosity of one of the trustees, Mr. Edw. E. Eyre. Some remarkably fine Roman bronze bath tubs from near Pompeii have been procured for the Museum by Dr. Brestrad.

Mr. Oscar Rohn has at considerable expense collected together series of 86 specimens of rocks from the Keeweenawan, the Penokee and the Marquette districts in the Lake Superior region. The collections represent all the important rock types found in these districts. They are intended more particularly to illustrate the reports of the United States geologists upon the copper and iron-bearing series of the Lake Superior region, though they may serve also as supplements to the collections of Paleozoic rocks at present furnished by dealers in geological materials, since they embrace specimens from the Algonkean and the Archean systems as recognized by the U. S. Geological Survey. The collections, having been made at the suggestion of Prof. C. R. Van Hise, may safely be accepted as typical. In spite of the great expense that has attended the making of the collection its price has been placed at $40.00. A rare opportunity is offered to practical geologists and to teachers of geology in our colleges to secure a trustworthy set of rock specimens from one of the most interesting geological regions in the United States. It is hoped that the offer will be availed of, and that Mr. Rohn may be induced to collect from other much discussed districts.

RECENT LITERATURE.

Zur paläozoischen Flora der Arktischen Zone by A. G. Nathorst, Zur Fossilen Flora des Polarländer, I, Theil, 1 Lief, 80 pp., XVI pl., Stockholm, 1894.

In this memoir on the Paleozoic Flora of the Arctic Zone, Dr. Nathorst presents a comprehensive and exhaustive review and revision of the Paleozoic plant material brought by the various expeditions from the Arctic regions. Following in the footsteps of Heer, he has been so fortunate as to have in hand not only all the Arctic specimens hitherto described, with the exception of the fragments brought by McClintock from Mellville Island, but also important later collections made from several localities in the Devonian and Eocarboniferous of Spitzbergen by De Geer and himself in 1882.

The results of Nathorst's work diverge along three lines, viz., the material imperfectly or often erroneously figured or described by Heer is presented in its true relations with detailed accuracy, and is supplemented by the more recent collections; the geological age of the fossiliferous teranes is more definitely fixed; and the identity or affinity of the floras with the others of the same age in lower latitudes is verified and found to constitute important evidence of climatic uniformity.

In the strictly paleobotanic portion of the memoir, which is most useful to students of fossil plants, there are, besides the refiguration and redescription of many of Heer's types, numerous points of special interest. To mention the many interesting species found, or the valuable specific correlations made by Dr. Nathorst, would far exceed the space available in a short notice. Among the more notable cases in the former class are the new provisional genus *Pseudobornia*, and the elaborations of the characters of *Cyclostigma* Haughton, which is here included in *Bothrodendron*, though a subgeneric differentiation is suggested. *Pseudobornia* appears, as its name indicates, to be Calamitic in its nature, though no prejudice is expressed as to its relations or possible identity with *Bornia* or *Calamites*. *Pseudobornia ursina* Nath. is very suggestive of *Calamites inornatus* Dn. The existence of a Knorrid stage in *Bothrodendron* is made plain beyond doubt, while the absense of both *Lepidodendron* and *Sigillaria* in the Bear Island Ursa beds, gives rise to a strong presumption that the *Stigmariæ* found there are to be referred as roots to *Bothrodendron*, which Nathorst seems to think may have been the ancestor of *Sigillaria* and *Lepidodendron*.

The flora of the Liefde Bay system of Spitzbergen with species of *Cyclopteris*, *Lepidodendron*, *Bothrodendron?*, *Psilophyton*-like stems, and *Psygmophyllum*, while, indicating a Devonian age, is insufficient to warrant with confidence a closer correlation. A comparison, however, of Nathorst's figures shows a close relation of the Arctic Lepidodendra with the American Upper Devonian species. It seems to the writer that the *Psygmophyllum williamsoni* Nath., which is regarded by Nathorst as a Gymnosperm, deserves a comparison with our *Archæopteris obtusa* Lx., or the *A. archetypus* Schmalt.

The flora of the Lower Carboniferous of Spitzbergen with *Sphenopteris bifida* L. and H., and other species (several of them new) of *Sphenopteris*, *Adiantites*, *Cardiopteris*, *Archæopteris*, *Lepidodendron*, *Halonia*, *Bothrodendron* (*B. tenerrimum* A. and T.), *Carpolithes*, and *Samaropsis*, is closely related to, when not identical with, species in the Caliciferous Sandstone and Lower Carboniferous Limestone of Great Britain, or the Culum of continental Europe. Several of the species, e. g., *Sphenopteris sturii* Nath., *S. flexibilis*, *S. kidstonii* and *Lepidodendron spitzbergensis* are very close to, if not identical with plants found in the Pocono (Vespertine) series of the Alleghenies, or the Horton series of Nova Scotia, though the general aspect of the flora seems as a whole to be somewhat younger.

The "Ursa" flora of Bear Island, with *Calymmatotheca, Pseudobornia, Lepidodendron* cf. *pedroanum*, and *Bothrodendron* (*B. kiltorkense* and others), has, with the exception of the comprehensive *Stigmaria ficoides*. nothing definite in common with the Lower Carboniferous flora, and appears to be nearest related to the *Kiltarkan* flora of upper Devonian age, or perhaps it represents the transition from the Devonian to the Carboniferous.

Finally, Dr. Nathorst discovers no difference in the character of the vegetation in the Devonian or Lower Carboniferous of the Arctic zone and that of the contemporaneous deposits in other parts of Europe, both the ferns and the Lycopods being of full size and apparently grown under conditions equally favorable, so that, so far as yet known, fossil plants offer no evidence of a difference in climate at those periods, between the Arctic and the lower latitudes of Europe. We may add that the same climatic conditions appear to have existed contemporaneously in the Appalachian region of the United States.—DAVID WHITE.

A Biological Examination of Lake Michigan in the Traverse Bay Region.—The Sixth Bulletin of the Michigan Fish Commission bears this title and in some one hundred pages records the work done by Dr. H. B. Ward and an efficient corps of assistants. Besides Dr. Ward's report, there are to be found within the covers of the bulletin the reports of five others, either assistants or those to whom specimens were sent. Aquatic plants are treated by H. D. Thompson, the Protozoa by Dr. C. A. Kofoid, the Rotifera by H. S. Jennings, the Turbellaria by Dr. W. McM. Woodworth and the Mollusca by Bryant Walker.

The objects of the work were a study of the life of the lake in all its manifold relations and especially of those factors which bear upon the welfare of food fishes in general and of the young white fish in particular.

The more important conclusions that Dr. Ward arrives at are:

That 63 per cent of the food of the common white fish, *Coregonus clupeiformis* consists of Crustacea. Twenty per cent of this is formed by *Mysis relicta* Loven, and 43 per cent by *Pontoporeia hoyi* Smith. After the crustacea come small mollusks at the rate of 26 per cent, made up mostly of several species of *Pisidium*.

That the ultimate source of the food supply is found in the plankton of which he estimates that there is for Lake Michigan almost 9,300,000 cubic meters, representing a weight of from 102,300 to 118,600 metric tons, or 12 to 16 pounds to each acre of surface. With Hensen he concludes that the productiveness of the water about equals that of the land; but, at the same time, he points out that there is an element of error in these comparisons since they are made with an artificial productiveness in the land.

The plankton does not occur in swarms; and that it gradually increases to a depth of 30 meters, below which it decreases. The variations found in distribution through different strata of water are probably due to vertical migration.

The uniform distribution of the plankton indicates that the fish feeding upon it find a limited food supply everywhere.

The bottom flora and fauna are not sufficient to maintain large numbers of bottom fish. The well known migrations of white fish along shore seem thus to be correlated with the non-localized food supply.

There is a plentiful supply of white fish food on the old fishing grounds and no reason can be given for a diminution in the supply of white fish except over catching.

Finally he speaks strongly and with the very best of reason in favor of the fisherman and pisciculturist being given the same governmental attention that is given the agriculturist. Piscatorial stations where the best of investigatorial talent may be employed continually would not only offer the best means for preventing the extinction of the food fishes, but would enable the piscatorialist to maintain a good supply.—F. C. Kenyon.

Proceedings of the Indiana Academy of Sciences for 1895.—Several times we have had occasion to notice the volumes put out by the Indiana Academy of Sciences, and always in a favorable manner. The present volume, recently issued (although its title page bears date February 1896) proves no exception. These 300 pages contain papers on mathematics, physics, chemistry, botany, zoology, physiology and hygiene, the total presented in full or in abstract numbering. Of these, but a few can be mentioned here. In his presidential address Mr. A. W. Butler discusses the changes in the flora and fauna which have occurred since the beginning of the century and these changes have been numerous and important. Many are the animals, once abundant, which are now rare or exterminated. Read Audubon's account of a pigeon roost and now "a single pigeon in a year." Mr. A. H. Purdue presents his studies of the earthquake of Oct. 31, 1895, the greatest in the Mississippi Valley since 1811, and the interesting fact was brought out that its epicentrum nearly coincided with that of the New Madrid earthquake. Science, apparently, is not favored by those having charge of the State Library, if we can judge from the catalogue of the botanical literature which is contains. The Academy should endeavor to change this. Certainly Science should be as well treated as literature in a state library. Mr. R. E. Call revises the Unios allied to *U. parvus*, doing it in a way to please those who do not believe, with the late Dr. Lea, that we have over 600 fresh water clams in the United States. There are two or three papers on fishes, but most important is one by Evermann and Scoville upon the spawning of the blue back salmon of the Pacific rivers. These studies were made in the lakes of Idaho and the conclusion is drawn that these fish spawn but once and then die, and that the well known mutilations are received on the spawning beds while making their nest.

The Academy is trying to make a thorough biological survey of the state and hence the local lists published have no little value. These include molluscs, birds, fishes, the bird notes of Mr. Butler being especially valuable from their fullness. Prof. Stanley Coulter reports upon the collections of plants—nearly a thousand species—that have come into the possession of the Academy ; but the first place in importance, though the last in the volume, should be given Prof. Eigenmann's report of the biological survey of a limited fauna—that of Turkey Lake. The physical features of the lake are described in detail and small collections are reported upon by several persons but most interesting and valuable are the studies of variation, the preliminary stages of which are reported upon. Such studies carried on in this manner would be of great value did they only give us results of use in systematic science ; but they promise more than that.

The State of Indiana for two years past has published the Proceedings of the Academy, and it should continue to do so. There is not a state organization of similar character anywhere which is doing better work than is this. Its members are working for the good of the State, and this without any hope of gain. The State should make the results of these labors accessible to all.—J. S. K.

Beal's Grasses of North America.[1]—About ten years ago Dr. Beal, brought out his useful Vol. I, and now we have the companion volume after many years of waiting. The first volume treated the subject somewhat agriculturally while here we have a scientific description of every species occurring in North America, including all the cultivated species also.

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[1] *Grasses of North America*, by W. J. Beal, Ph. D., in two volumes. Vol. II, pp. viii, 706, 8vo, with 126 figures. New York, Henry Holt & Company, 1896.

The plan of the work is excellent and in the main it is well worked out. The sequence followed is that of Hackel in Engler and Prantl's *Naturalichen Pflanzenfamilien.* The characterization of each division and tribe is full and apparently well drawn, and under these the descriptions of genera and species are equally well made. Occasionally one notices a little redundancy of words, but this is a fault which will displease very few. We are so accustomed to short and insufficient descriptions that it is quite gratifying to find descriptions in which there is something to spare. To a large extent these descriptions are new, at least the book is not a mere compilation of scattered descriptions. The student will find here, for the first time, descriptions of all our grasses, 809 native and 103 exotic species. The author has attempted to illustrate nearly every genus, and he has succeeded so well that of 146 genera, 126 are figured. Some of these figures are crude, and the lettering in some is cruder still, but taken as a whole, they are helpful, while many are very well done.

We notice with pleasure that the nomenclature is in accordance with the "Rochester–Madison Rules," and, contrary to what some have feared, the changes in well known names are not many. The synonomy is full, but has not been as carefully collected as it should have been, due probably to the employment of clerical help. We notice with regret also that the range of many species of the Plains has not been acurately given, although authentic lists, and even herbaria, could have readily been consulted. These errors of omission and commission are, however, not so great as to be seriously harmful, and they can easily be corrected in a second edition. As it is, the work will be very useful, and American botanists are deeply indebted to the author, for completing this laborious task.—CHARLES E. BESSEY.

Brush's Determinative Mineralogy and Blowpipe Analysis.[2]—This most valuable text-book on blowpipe analysis, with tables for the determination of Mineral species by blowpipe methods has long been the standard text used in our colleges. The first part (Blowpipe Analysis) has now been entirely rewritten and enlarged from 62 to 163 pages. The valuable tables which were based on von Kobell's *Tafeln zur Bestimmung der Mineralien* are now in process of revision for a later edition of the work. As these tables comprise but 33 double pages against 163 pages of the text devoted to blowpipe analysis, it seems to the reviewer that it would be well to change the title to Blowpipe Analysis and Determinative Mineralogy, which would then indicate the natural order of considering these subjects and the one followed in the book.

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[2] *Fourteenth Edition, Revised and Enlarged,* by Prof. S. L. Penfield. Wiley, $3.50.

The new text is admirably written and of especial value because of the discriminating judgment that has been shown in selecting the characteristic tests for the elements. When no really satisfactory blowpipe test for an element exists the author recommends a test employing the wet methods. In order to make the work as complete as possible tests for the rarer elements are included but appear in finer print. Valuable hints concerning the best quantity of material to be used in each case and little "tricks" of manipulation which are usually only learned after considerable experience in applying the methods abound in the book. Mineralogists generally will rejoice to see this valuable work brought up to date by so experienced and so accurate a mineralogist as Professor Penfield and will look forward with interest to the appearance of the revised tables. The author announces in his preface that he intends to add a chapter to the work so as to treat briefly crystallography and the physical properties of minerals.—WM. H. HOBBS.

Chudzinski on the Facial Muscles.[3]—M. Chudzinski, who for many years was the preparateur of anatomy, and the active colleague of Paul Broca, has just published a work of well matured thought, the result of dissections carried on by the author during twenty-five years. This paper comprises a study of the muscles of the face and neck in many different races of men, their variations, their anomalies, and their analogies and differences with those of the monkeys. When it is considered that these muscles are the ones that control the physiognomy, that is to say, control the expression of mind, one can appreciate the interest whirh this work of M. Chudzinski will have, not only for anatomists, but also for anthropologists and artists.

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[3] Some Observations on the Muscles of the Human Skull and Face, by Theophile Chudzinski, Assistant in the Laboratory of Anthropology at the School of Hautes Etudes, Member of the Society of Anthropology, Laureate of the Academy. One volume in 8vo, with 25 figures in the text. 4 fr.

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General Notes.

PETROGRAPHY.[1]

The Basic Rocks of Devonshire.—The diabases of southern Devonshire, England, have been carefully investigated by Busz.[2] The diabases occur in floors often between Devonian slates and schists. The plagioclase of a specimen from Anstie's Cove, near Torquay, is partially changed to prehnite. All specimens contain brown hornblende, which is regarded as original. At Babbacombe the diabase is full of porphyritic crystals of labradorite. The groundmass in which these lie is composed of a second generation of plagioclase in a serpentine-like secondary matrix, which has been derived from the augite and other components of the original rock. Both porphyritic and groundmass plagioclases are deformed as the result of pressure. At Highweek blocks of a pale pikrite were found. Their material is identical in appearance with the rock of Nassau. It consists of olivine, augite, feldspar, biotite, enstatite, apatite and magnetite. The rock is very much altered. Its composition, as shown by analysis, is:

SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	Na_2O	K_2O	H_2O	TiO_2	P_2O_5	FeS_2	Total
40.12	7.76	7.35	8.66	6.53	23.69	1.20	.53	4.03	.37	.18	.20	=100.62

It contains also traces of Cl, CO_2 and Cu.

Along the banks of the Avon, at South Brent, blocks of Kersantite are met with. The rock possesses no noteworthy features, except that in it are crystals of orthoclase surrounded by zones of newly formed plagioclase.

The Magmatic Alteration of Hornblende and Biotite.—Hornblende and biotite in many igneous rocks are surrounded by zones of augite and magnetite that have resulted from their alteration. The process by which this zone or rim has been formed is generally looked upon as a chemical one. The rock magma is supposed to have fused the hornblende or biotite grains, or to have partially dissolved them, and from the resulting mass the augite and magnetite are believed to have crystallized. Washington,[3] in a recent article, discusses this theory. He shows that the alteration is confined almost exclusively to the constituents of the intermediate and basic volcanic rocks. It is not a phenomenon of acid rocks, nor of plutonic basic ones. The author believes that the two minerals named are formed under intratellurial conditions, and that when the conditions are changed to those prevailing at the surface the complete but homogeneous compounds break up into a heterogeneaus aggregate of simpler ones, *i. e.*, becoming paramorphed. It is believed that many of the grains of augite and magnetite scattered through certain volcanic rocks may have been components of these paramorphs that have been carried from their original positions by magma movements. Some of the augite andesites are thought to owe their augitic constituent to the processes above outlined.

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Neues Jahrb. f. Min., etc., 1896, I, p. 57.

Petrography of the Little Rocky Mountains, Mon.—The Little Rocky Mountains are situated in central Montana, about 180 miles east of the Rocky Mountains proper. They are formed by a dome-shaped uplift of Paleozoic and older rocks in the midst of horizontal cretaceous strata. The nuclear rocks are classed by Weed and Pirsson[4] as Archean-Algonkian, because consisting of various schists associated with a quartzite. Around these and covering them, over much of the extent of the mountains, are porphyries that grade in places into phenolitic facies. The rock was extruded as a laccolitic mass, which now partially covers the Archean schists. In the main it is a granite porphyry, containing orthoclase and oligoclase phenocrysts in a fine grained groundmass composed almost exclusively of orthoclase, anorthoclase and quartz. This rock is replaced occasionally by a syenite-porphyry, or by a granite-diorite-porphyry, which differs from the granite-porphyry in the presence of chloritized augite and in the predominance of plagioclase phenocrysts over orthoclastic ones. At two places tinguaite replaces the normal rock. This phonolitic phase is a dense, dark-green rock, that is apparently a contact phase of the normal porphyry. In their section the tinguaite shows large phenocrysts of sanidine and smaller ones of augite in a fine groundmass of alkali-feldspars, aegirite and nephelite. The syenite-porphyry from Lookout Butte is characterized by the absence of all minerals but the feldspars and a little quartz, and by the fact that the feldspars of the groundmass are almost exclusively albites. An analysis of the predominant granite-porphyry yielded:

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[3] Jour. Geol., Vol. IV, 1896, p. 257.

[4] Jour. of Geology, Vol. IV, 1896, p. 399.

SiO_2	Al_2O_3	Te_2O_3	FeO	MgO	CaO	Na_2O	K_2O	TiO_2	BaO	S_2O	H_2O	Cl	Total
68.65	18.31	.56	.08	.12	1.00	4.86	4.74	.20	.13	.10	1.10	.03	=99.88

The Volcanic Rocks of Bolsena, Italy.—The volcanic rocks of the Bolsena region in Italy are reported by Washington[5] to comprise two distinct types—the trachytic and the leucitic. The former include andesite and vulsinite, a rock that differs from normal trachyte in containing a great deal of plagioclase and occasionally some olivine. The plagioclase is anorthite. Both this mineral and the large crystals of orthoclase that occur as phenocrysts are surrounded by mantles of orthoclase in optical continuity with the nuclear grains. An analysis of the rock gave:

$S:O_2$	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	P_2O_5	Ign	Total
58.21	tr	19.90	4.07	.87	.98	3.58	2.57	9.17		.74	=100.09

The vulsinite is thus an effusive rock intermediate in character between trachyte and andesite.

The leucite rocks are leucitites, leucite-phenolites (leucite-orthoclase), leucite-tephrite and leucite-basanites. All these rocks are briefly described by the author.

The Analcite-bearing Rocks.—Pirsson,[6] in a general article on the monchiquites and other related rocks gives the results of his study of a number of interesting rock types, all of which contain analcite. The glassy base of monchiquites is shown to have the properties of this mineral. Analcite is also thought to be present in many other rocks as an original component. The conditions favorable to its production are those that obtain in dikes or other small intrusive masses—they are dike forms of theralites on the one hand, and tephrites, nephelinites, etc., on the other. There exists, according to the author, an analcite group of rocks, just as there exists a leucite group. The monchiquites are analcite basalts and the fourchites are analcitites.

Petrographical Notes.—Callaway[7] gives a brief account of the origin of schists of the Malvern Hills, England. The rocks were originally diorites, epidiorites, granites and felsites. They have been changed to schists by the usually processes of dynamic metamorphism. The banding of some of the schists is due to interlaminations of igneous rocks of different characters.

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[5] Jour. Geol., Vol. IV, 1896, p. 542.

[6] Jour. Geol., Vol. IV, 1896, p. 679.

[7] Proc. Liver. Geol. Society, 1895–96, p. 453.

Several new occurrences of alnoite are described by Smyth[8] from near Manheim, N. Y. The rock of a small dyke does not differ in any essential respect from the rocks described a few years ago. The rock of a large dyke is very fine grained on the margin of the dyke, but in its interior it is a coarse grained panidiomorphic aggregate of reddish-brown mica and serpentine pseudomorphs after olivine, together with a little magnetite, apatite and perofskite. Melilite has not been observed in the rock, but the author thinks that it may have been present before alteration set in.

In the report on the the Mine la Motte sheet of the Missouri Geological Survey, Keyes and Haworth[9] describe the Archean rocks found within the district as granites which pass upwards into prophyries. Some of the granites are granular, while others are porphyrtic. In composition they are normal. The porphyries are like those of the Iron Mountain district. The acid rocks are cut by intrusions of diabase, and of quartz disabase porphyrites.

In a collection of rocks from the Provinces Kansu, Schensi, Hupe and Honan, in China, Steuer[10] finds granites, hornblende-vogesite, melaphyre, serpentine, amphibolite, gneiss, and various schists and sediments.

GEOLOGY AND PALEONTOLOGY.

Lambdotherium not Related to Palæosyops or the Titanotheres.—The little species *Lambdotherium popoagicum* of the Wind River beds, found contemporary with *Palæosyops borealis*, has been treated by Cope, Earle and others as an ancestral titanothere. A more careful examination of the numerous specimens in the American Museum shows at once that it bears much closer resemblances to the horses, especially in the chisel-shaped incisors, the atlas, the manus and pes.

A restatement of its definition and principal characters appears to be of value.

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[8] Amer. Jour. Sci., 1896, Vol. II, p. 290.

[9] Missouri Geol. Survey, Sheet Report, No. 4. p. 24.

[10] Neues Jahrb. f. Min., etc., 1896, II, p. 477.

Gen. Lambdotherium Cope. Incisors chisel-shaped. Premolars relatively reduced, a wide diastema in front of $p\frac{1}{1}$. Superior molars bunoselenodont with an oblique ectoloph, including a very prominent parastyle and sharply defined mesostyle; protoloph with a sharply defined protoconule. Manus with the fourth digit reduced, functionally tridactyl with lunar widely displaced.

L. popoagicus Cope.[1] This species was established upon two mandibular rami with the anterior and posterior portions fractured (Am. Mus. Cope Coll., 4863). The animal is small (pm2–m3=.069), ranging in size between the largest Hyracotheres and smallest species of Palæosyops (*P. brownianus*). Remains of twenty individuals are now contained in the American Museum, Cope Collection. The number of incisors is unknown and it is also uncertain whether there are three or four premolars. The incisors are chisel-shaped. The canines are sharply pointed. The second and third upper premolars have single internal lobes. The form of the molars is very characteristic; they differ from the contemporary Hyrachothere molars in the obliquity of the ectoloph, the prominent parastyle and sharply defined mesostyle, the protoconule is acutely triangular, while the metaconule is not defined but merged in the low metaloph; in fact, the inner half of the crown is quite like that of the early horses. In the lower jaw P_2 is a laterally compressed protocone, P_3 has rudiments of additional cusps, P_4 is submolariform with its tetartocone rudimentary or absent.

The lambdoidal lower molar crests give the name to the genus; the the paraconid (as in the Hyracothere) is feebly reduplicate; in M_3 the hypoconulid varies from a conic to a selenoid or crested form. The few skeletal characters known are very significant (See Am. Mus., Cope Coll., No. 4880). As in the Equidæ the vertebrarterial canal passes through the upper side of the transversal process of the atlas. The displacement in the manus is extreme, the lunar resting on the unciform and demonstrating that although four toes existed the foot was mesaxonic; at the same time the median digit was not greatly enlarged, indicating that the foot was of an iso-tridactyl type. The pes exhibited a deeply grooved astragalus, judging from the tibial articulation. A doubtfully associated astragalus (No. 4904) shows widely separated inferior and sustentacular facets as in the horses.

Remains of the tibia, of the calcaneum and other characteristic limb bones all resemble the corresponding parts in the contemporary Equidæ.

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[1] Am. Nat., 1880, p. 748, Tert. Vert., p.

This animal differs, however, from the contemporary horses in the prominent median cusps (mesostyle) of the superior molars, and the asymmetry of the outer wall (ectoloph) caused by the prominent parastyle. This forbids our placing it with the true line of horses. The molars and the pes resemble those of the imperfectly known *Triplopus amarorum* a species whose relations to *Triplopus* the writer has always doubted.

It appears possible that we have here another side line of perissodactyls, related to the horses.—HENRY F. OSBORN.

Development of the Foot in the Palæosyopinæ.—The following observations are based on the specimens contained in the collections of the American Museum of Natural History of New York.

The Lower Eocene member of the group, *Palæosyops borealis* Cope, was rather slenderly built, with comparatively long toes, well separated. With the great increase in size in the Middle and Upper Eocene came a corresponding change in foot structure. Two types developed, one with short broad foot, the toe bones short, stout and widely spreading; the other with longer and rather stilted foot, the metapodials long, but set close together. The former type is that of Palæosyops, and is correlated with a short wide head and general stout heavy build. The latter is the Telmatotherium type, and is associated with long heads and probably much more slender form. The species can be conveniently distinguished by two characters in the astragalus, viz., the length and thickness of the neck, and the shape and relations of the sustentacular facet.

In an astragalus referred to *P. borealis*, the neck is moderately long and not thickened at the base. The sustentacular is a rather long oval, and scarcely separated from the distal (cuboid and navicular) facets. In our specimens of *P. laticeps* Marsh, the characters are much the same as the above. *P. paludosus* Leidy, and *P. ultimus*[2] Osborn, have a broad, short-necked astragalus, the sustentacular facet, in the former species at least, being short-oval and generally (but not always) well separated from the distal facets.[3] The other (Telmatotherid) line shows a slight lengthening and considerable thickening of the neck, and a change in the shape of the sustentacular facet, either to an extremely long oval, separate from the distal facets, as seen in a specimen referred to *T. hyognathum* Scott & Osborn, or else a long triangular shape, confluent at its base with the distal facets, as seen in *T. cornutum* Osborn, of the lower Uinta. In the small species *T. megarhinum* Earle, the primitive type persists through to the Lower Uinta, with some lengthening of the neck of the astragalus and of the sustentacular oval. A Bridger specimen of *T. cultridens* is more advanced, being intermediate between *megarhinum* and the supposed *hyognathum*. *Diplacodon* in the Upper Uinta, shows a short neck, but the facet was long elliptical, tending towards confluency; it appears more nearly allied to the persistent primitive forms than to either extreme type, as shown in *T. cornutum* on the one hand and *P. paludosus* on the other. These characters of the foot-structure appear to be mainly dependent on the size of the animal and are, therefore, of little taxonomic value; but there appears to be a valid distinction between the long-footed Telmatotheres and the short-footed Palæosyops, which may serve as a further reason for separating the two genera. It must be remembered, however, that intermediate forms were abundant, and gave rise, probably, to the later Titanotheres.

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[2] Species not yet described.

[3] It is not so, apparently, in the Princeton specimen described by Earle in his Memoir on Palæosyops.

In all but two of the above mentioned species the foot material is associated with skulls more or less complete. The determinations of the latter are on the authority of Osborn and Earle, and they will be fully described by Prof. Osborn in a forthcoming paper, this note, by his kind permission, being published in advance.—W. D. MATTHEWS.

The Western American Lœss.—In a paper read before the Iowa Academy of Sciences Mr. B. Shimek states that his investigations concerning the deposition of the Lœss of Iowa have convinced him that the theory of the lacustrine origin of the deposit and its origin in violent fluviatile floods are equally untenable. He offers instead the theory that the lœss is of æolian origin, and that it was deposited principally in forests and to a lesser extent in dense growths of smaller plants, while proportionately small quantities only were carried directly into the waters and there deposited.

The author adduces the following facts to show that the lœss is not of aquatic origin:

"First.—The land area during the period of the formation of the lœss was large as is shown by the remains of great numbers of terrestrial mollusks."

"Second.—The occurrence of dry region mollusks, many of which species are now living throughout Iowa and eastern Nebraska, particularly in wooded regions."

"Third.—The deposits often occur so high above the surrounding region that it is difficult to conceive of the manner in which water laden with the fine silt could reach the place of deposition."

"Fourth.—The siliceous and other particles which the lœss contains are generally angular and often show a freshness of fractures which would scarcely appear in particles which had been rolled and washed about by the waters."

"Fifth.—The distribution of the lœss is better accounted for by the consideration of the action of the winds, and by the distribution of the forest areas."

Mr. Shimek adduces evidence demonstrating (1) that the lœss was deposited under climatic conditions essentially the same as those which prevail in the same region to-day; and (2) that the deposition was slow and continued through a period of considerable extent; and (3) that a forest lying adjacent or near to drift covered plains is especially favorable to the deposition of lœss.

The differences between the lœss of eastern and western Iowa are in accordance with the general topographical and climatic differences which probably existed during the lœss period, as they do now.

In considering the time element the author estimates the deposition to go on at the rate (minimum) of one mm. a year. If this be correct the time required for the formation of the entire deposit would not be unreasonably great. (Proceeds. Iowa Acad. Sciences [1895], 1896.)

The Extinct Birds of Chatham Island.—The Tring Museum is in possession of an immense collection of bird remains from the Chatham Islands, consisting of many thousands of bones. The collection is being worked up by Mr. C. A. Andrews, and the results published in Novitates Zoologicæ. From so large a mass of material Mr. Andrews was able to obtain nearly complete skeletons of several of the extinct species, and to form a tolerably accurate idea of the degree of individual variation in some of them. The first paper on the subject appears in the March number (1896) of the publication above mentioned. It comprises a detailed description of the osteology of Diaphorapteryx, prefaced by a brief explanation of the adoption of the generic name. In closing he calls attention to its close resemblance to Aphanapteryx, and discusses Milne-Edwards' statement that the similarity of the two forms is a strong evidence that the islands in which they occur, viz., Mauritius and Chatham were formerly connected with the great Antarctic Continent. The author is inclined toward Dr.

Gadow's explanation that the likeness of the two forms is the result of parallism in evolution.

The ancestors in the two cases, generalized rails capable of flight, were probably of different genera, or, at least, of different species.

A second paper (Sept., 1896) gives the osteology of *Palæolimnas chathamensis* and *Nesolimnas* (gen. nov.) *dieffenbachii.*

The proportions of Palæolimnas, together with the considerable size of the sternal keel and the deep impression of the insertion of the *Pectoralis major* on the crest of the humerus leads the author to state that "it seems probable that Palæolimnas may have still been capable of heavy flight for short distances."

Of Nesolimnas, the new genus, Mr. Andrews remarks as follows:

"In Nesolimnas we have an annectant form linking the flying to the flightless rails. In its plumage, in the condition of its sternum, and in many other points, it reminds us of Hyopotænidia; while on the other hand, in the reduction of its wings and the consequent modification of its hind limb it approaches Ocydromus. The existence of such an intermediate type seems to give strong support to the opinion that the Ocydromine rails have originated from forms capable of flight at a comparatively recent date and in the islands they now inhabit."

Both papers are profusely illustrated.

BOTANY.[1]

Climatic Influence of Lake Erie on Vegetation.—In a small district in northern Ohio, including Erie County, Sandusky Bay and the peninsula that bounds it on the north, with the islands of the Put-in-Bay group, there are growing wild 103 species and varieties of phanerogams, which so far as known have not been found anywhere in Michigan, 118 not found in Canada, and 233 not within fifty miles of the city of Buffalo, at the east end of the lake.

Lake Erie is not a barrier to the dispersal of seeds, but it affects differently the climate of places on its different sides, making each different from the others and different from that of places lying in the same latitude, but not near the lake. The south shore is protected from north winds, and receives the full benefit of those from the opposite direction, while it is the reverse with places on the north side; but why such a great difference in the vegetation at the east and west ends? Is it not due to something else than climate? Let us see. At Buffalo the mean temperature in summer is about four degrees lower than at Sandusky. In the spring months the difference is even greater, being five degrees in April and nearly five in May and in June. The prevailing winds are from the southwest, and traverse the lake for nearly its whole length before reaching Buffalo, keeping it cool in summer, the temperature not having exceeded 92° since the establishment of the weather bureau there twenty-six years ago. Moreover, at the opening of spring the wind takes the ice with it to the east end of the lake, where it remains so crowded as to prevent navigation three weeks or more after Sandusky Bay is clear. The average date of the last killing frost in spring at Sandusky is April 30th, at Buffalo, May 20th. Moreover, Buffalo is not, like Sandusky, so situated as to be protected from cold northwest winds in autumn. Its first killing frost comes on an average September 15th; but at Sandusky it is not until October 24th—thirty-nine days later. The summer at Buffalo, counting the time between the average dates of killing frost, is about two months shorter than at Sandusky—118 days at Buffalo, 177 at Sandusky.

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[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

The fact that a number of plants belonging to the Sandusky flora have been found nowhere in Canada, except on the southernmost points, viz., Pt. Peleé Island and Pt. Peleé, which must enjoy nearly as much immunity from frost in spring and autumn as the United States shore immediately to the south of them, implies that the climate elsewhere is too severe for them, and probably for most of the 118 Sandusky plant that are not known to grow in Canada at all. The influence of the climate is further shown by the fact that besides 103 species which have not been found in Michigan at all the Sandusky flora includes a number that have been found only in the southern and especially the southwestern part, where Lake Michigan affords them some protection from frost.

It is interesting to observe that the protection from frost afforded by Lake Erie scarcely extends beyond the counties that border upon it, and as a result we have many plants in these that have not been reported from any other county north of the middle of the State, and quite a number that have been found nowhere else in Ohio except in the southern part, within forty miles of the Ohio River. Even so far south as Columbus the first killing frost in autumn occurs on an average six days earlier than at Sandusky.

When Lake Erie subsided after the melting of the glacier, and Marblehead emerged from the water, it was left bald, so to speak, for whatever deposit the glacier may have left upon it was washed off from most of it by the lake. The same was true of portions of Kelley's Island and Put-in-Bay, and here, where one would expect to find a moist climate, the scant soil formed by disintegration of the limestone becomes more parched under the summer sun than any spot in Ohio farther east. I doubt if another place could be found in the country as far east where there are so many plants that belong to the western plains as on Marblehead.

Having shown that the conditions of climate and soil near the southwestern extremity of Lake Erie are peculiarly suited to southern and western plants, it remains to indicate briefly how the seed succeeded in getting so many miles away from home, though the problem is no more difficult than accounting for the dispersal of any rare plant that is found only at widely separated stations. The seeds of the Compositæ, which are the best represented of all, might many of them have come on the wings of the wind, and so with Asclepias and others. The seeds of *Ammania coccinea* and *Rotala ramosior* may have stuck to the feet of a heron while it flew from some southern river bank. *Desmodium illinoense, Desmodium sessilifolium* and some others may have been brought by cattle, which, before the time of railroads, were driven from Illinois east by way of Marblehead and Cedar Point, being made to swim across the channel that connects Sandusky Bay with the lake. At an earlier day, when the bison roamed as far east as Lake Erie, seeds of various kinds must have clung to its hair. Others, probably came with the Indians, who seem to have been attracted by the good fishing in this region. Few, if any, are such as have fruit whose seeds are dropped by birds. Fruit-eating birds in migrating would carry northward only those whose fruit survives the winter.

Following is a list of plants which, on the south shore of Lake Erie, I believe occur farther north than anywhere else in this part of the country. Some of them in the west, where the summer isotherms bend to the north, extend to southern Minnesota. As a number of these are both southern and western in distribution, I include in the same list some that appear to reach their eastern limit near Sandusky. Only a few of either the southern or western species extend east along the lake as far as Cleveland. Quite a number, I believe, have not hitherto been recorded as occurring as far north by one hundred and fifty miles, or so far east by a still greater distance.

Viola pedatifida, Desmodium sessilifolium, D. illinoense, Baptisia leucantha, Psoralea melilotoides, Petalostemon candidus, P. violaceus, Ammania coccinea, Rotala ramosior, Spiræa lobata, Eryngium yuccæfolium, Thaspium aureum trifoliatum, T. bardinode angustifolium, Actinella acaulis glabra, Aster shortii, Boltonia asteroides, Eclepta alba, Helianthus grosseserratus, H. hirsutus, H. mollis, H. occidentalis, Eupatorium altissimum, Kuhnia eupatorioides, Liatris squarrosa, Solidago rupestris, Asclepias sullivantii, Phacelia purshii, Cuscuta decora, Conobia multifida, Gerardia auriculata, Seymeria macrophylla, Lippia lanceolata, Euphorbia dentata, Populus heterophylla, Smilax bona-nox, S. ecirrhata, Juncus scirpoides, Carex conjuncta, C. shortiana, Poa brevifolia, Equisetum lævigatum.—E. L. MOSELEY, Sandusky, Ohio.

The Systematic Arrangement of the Protophyta.—In a recent study of the families and genera of the Protophyta I have reached some results which involve a rearrangement of the group, the general outlines only of which may be given here. It is, of course, here as elsewhere, a matter of individual judgment as to the value to be assigned to any structure in determining the place which a particular plant must occupy in a system, and it is doubly difficult when we are dealing with such minute and simple structures as the protophytes. Moreover, it is quite probable that some of the forms now thought to be distinct are only stages of others also given specific or generic standing. Nevertheless, we have here a great mass of organisms with sufficient autonomy to demand classification at our hands, and we may not excuse ourselves from this task merely because we do not know fully the life history of every species.

The following provisional arrangement has therefore been made as a result of a careful study of the whole problem. As will be observed, I have not considered the hysterophytic habit of some of the forms as entitling them to be separated widely from those to which they are structurally similar. In other words, the "Bacteria" are here not regarded as constituting a distinct family. Furthermore, it appears that "Bacteria" have arisen at various points in the protophyte system, so that it is now impossible to maintain a compact group of the hysterophytic genera. Indeed, it is highly probable that we should admit into some genera both holophytic (green) and hysterophytic (colorless) species, as, for example, the species of Schizothrix.

In the arrangement below, the hysterophytes are preceded by a star (*), so that the position of the "Bacteria" may be noticed at a glance.

ORDER I.—CYSTIPHORÆ.

Plants one-celled or associated in loose groups in a gelatinous matrix.

Family 1.—*Chroococcaceæ.*—Our genera may be disposed as follows:

A. Cells globose, dividing irregularly in three planes. Chroococcus, Glœocapsa, Aphanocapsa, Microcystis, Polycystis, Anacystis, Gomphosphæria, Cœlophærium, Clathrocystis.

B. Cells globose, dividing regularly in two or three planes. Merismopedia, *Sarcina.

C. Cells cylindrical, dividing in one plane only. Synechococcus, Glœotheca, Aphanotheca.

ORDER II.—NEMATOGENEÆ.

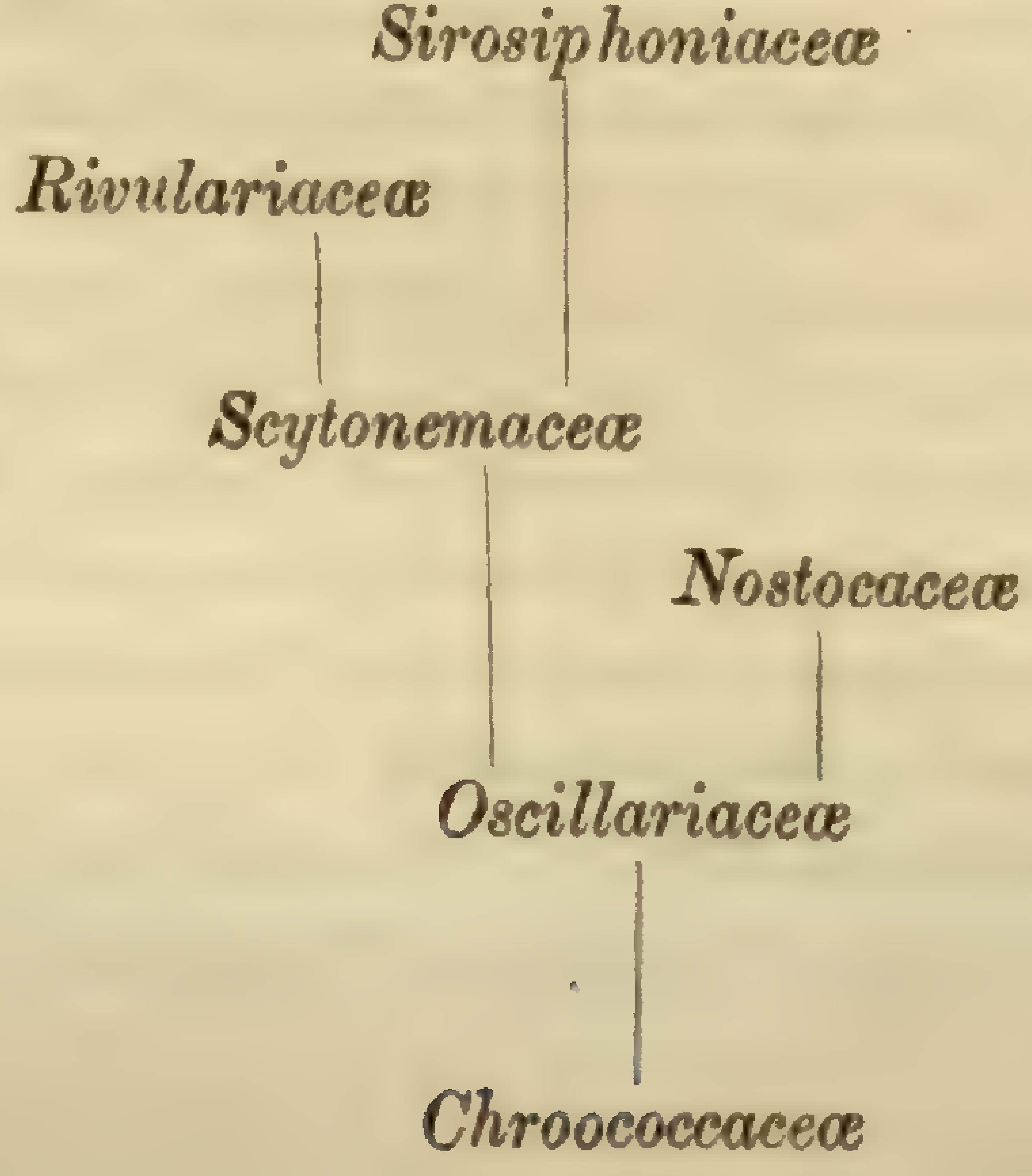
Plants several- to many-celled by division mainly in one plane, forming simple or branched filaments; cell-walls often thickish, and separating an outer continuous layer as a sheath, which encloses the row of cells.

Five families may be distinguished as follows:

A. Cells in each filament alike; no heterocysts. Filaments cylindrical, motile, *Oscillariaceæ.*

B. Cells differentiated; heterocysts present.
  a. Division of cells in one plane only.
    1. Filaments moniliform, unbranched, *Nostocaceæ.*
    2. Filaments cylindrical, sometimes spuriously branched, *Scytonemaceæ.*
    3. Filaments tapering, sometimes spuriously branched, *Rivulariaceæ.*
  b. Division of cells ultimately in three planes. Filaments with true branches, *Sirosiphoniaceæ.*

The relationship of these families to each other may be indicated by the following diagram:



The arrangement of our genera within the families may be as follows:

Family 2.—*Oscillariaceæ.*

A. Cells green or greenish; usually two or more filaments in each sheath; Schizothrix, Porphyrosiphon, Hydrocoleum, Dasyglœa, Microcoleus.

B. Cells green or greenish; filaments solitary in the sheaths, or sheathless; Plectonema, Symploca, Lyngbya, Phormidium, Oscillaria, Arthrospira, Spirulina.

C. Cells colorless; filaments without sheaths, or nearly so; *Leptotrichia, *Beggiatoa, *Bacillus, *Pasteurella, *Clostridium, *Cornilia, *Vibrio, *Spirillum, *Pacinia, *Bacterium. This series is parallel to B, and perhaps may eventually be merged into it. Certainly Spirulina and Spirillum are closely related, if, indeed, they are not identical.

Family 3.—*Nostocaceæ.*—Nostoc, *Leuconostoc, *Staphylococcus, *Micrococcus, Wollea, Anabæna, *Streptococcus, Aphanizomenon, Nodularia, Cylindrospermum.

Family 4.—*Scytonemaceæ.*—Microchæte, Scytonema, Hassellia, Tolypothrix, Desmonema.

Family 5.—*Rivulariaceæ.*—Calothrix, Dichothrix, Polythrix, Isactis, Rivularia, Glœotrichia, Brachytrichia.

Family 6.—*Sirosiphoniaceæ.*—Haplosiphon, Stigonema.

It will be observed that the "Bacteria" are confined to the first, second and third families, by far the greater number occurring in the *Oscillariaceæ.*

The "Slime Moulds" (*Mycetozoa*) are not here regarded as protophytes. These interesting and often very beautiful organisms I am reluctantly compelled to consider as falling outside of the dominion of Botany; and much as I dislike to do so, I am assured that we must surrender their study in the future to our zoological friends.—CHARLES E. BESSEY.

ZOOLOGY.

The Relation of Nuclei and Cyptoplasm in the Intestinal Cells of Land Isopods.[1]—Somewhat more than two years ago the late Professor Ryder and Miss Pennington (Anat. Anzeiger, Bd. IX, Nr. 24 & 25) announced the discovery of the fact that nuclei in the adjacent cells of the intestinal epithelium of *Porcellio* may become amoeboid, wander toward each other, and in some cases fuse together. This surprising fact the authors mentioned interpreted as a non-sexual form of conjugation; and, while recognizing its unique character, did not doubt that it was a normal phenomenon, even suggesting that it might have some relation to sexual conjugation.

Owing, however, to the entire novelty of these observations and interpretations the paper was received by many persons with considerable reserve. One author, W. Schimkewitsch (C. R. Soc. Natural., St. Petersbourg, 1895, I, and Biolog. Centralblatt, Bd. XVI, Nr. 5), while confirming the observation, denied that the nuclear fusion was a normal phenomenon. He interpreted it not as a form of nuclear conjugation but simply as as an artifact.

In the course of a study of amitosis, upon which I was engaged, it occurred to me that the phenomenon is question might be an irregular form of direct nuclear division; and with the approval of Dr. Mary Pennington, the junior author of the paper first mentioned, I undertook a review of that work.

My observations began with *Porcellio*, and were then extended to *Oniscus* and *Armadillidium.* On the whole the results of this review confirm the conclusions of Schimkewitsch. The phenomenon, which may be readily observed, is in most cases neither a form of nuclear conjugation nor division, but simply an artifact. I was first impressed with the fact, as was also Schimkewitsch, that in the most carefully preserved preparations relatively few of these so-called "conjugating nuclei" were found; on the other hand, in cases where the intestine was cut open before fixation, or was in other ways roughly handled, many of them occurred.

The shape and structure of these nuclei is such as to suggest the idea that they have been squeezed out of shape by some sort of pressure. They are most frequently long and pointed, with the chromatic substance condensed at one end, and with an empty nuclear membrane at the other, Figs. 1, 2 and 3. In some cases these nuclear processes are forked or branched, in others they are uniaxial. In adjacent cells the axes of nuclear elongation are frequently parallel; sometimes they radiate more or less regularly from a common area. The chromatic substance within these elongated nuclei is usually drawn out into rods or threads, which are parallel with the axis of elongation, Fig. 3. They frequently extend through several cells, and in a few cases were observed to protrude through the coelomic parietes of the cells. They show no marked tendency to fuse with each other, their long processes frequently passing through two or three cells without fusing with the nuclei of those cells. They are no more abundant in animals, which have been starved four weeks, and in which the alimentary canal has been for a long time entirely empty, than in animals which are well fed. In many cells the nuclei are broken up into several fragments, Fig. 2, each of which, though possessing no part of the original nuclear membrane, is yet sharply marked off from the cytoplasm. In all such cases the nucleus shows its characteristic staining reactions; in fact, the nuclear substance, though flowing through the cytoplasm, does not mingle with it. In general the nucleus and cytoplasm behave like two fluids, which are not miscible, *e. g.*, oil and water. In some cases, however, which will be described a little later, the substances of the nucleus and the cytoplasm appear to mingle at a definite point in the cell, and this under what seems to be normal physiological conditions.

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[1] Contributions from the Zoological Laboratory of University of Pennsylvania, No. VI.

The view that these distorted nuclei are squeezed from one cell to another is still further supported by the fact that the coelomic, and especially the luminal walls of these intestinal cells, are strong and thick, while sections show that in most regions the parietal walls are so thin that they cannot be distinguished; the nuclei might therefore easily pass through these parietal walls. The apparently well-marked cell boundaries which one observes in surface views of the intestine are really the superficial muscle fibres which run in the furrows between successive rows of cells.

I was at first inclined to attribute the source of the presumable pressure by which these bizarre forms of nuclei were produced to the contraction of these circular and longitudinal muscle fibres which, especially in the posterior portion of the alimentary canal, lie with great regularity between the successive circular and longitudinal rows of cells. The fact, however, that these abnormal nuclei may occur singly or in very narrowly circumscribed areas, and do not usually follow the lines of a single muscle fibre, whereas the fibres most probably contract as a whole, led to the abandonment in the main of this view.

A study of sections of the intestine show that almost every cell, and especially those in the anterior region of the alimentary canal, is traversed by bundles of very strong fibres, which run from the luminal to the coelomic side of the cell, and inclose the nucleus as in a barred cage, Fig. 4. These fibres when cut across curl slightly at the ends, showing that they are elastic; and it is possible that they may, under certain circumstances, contract, thus forcing the nucleus out through the bars. The presence of these fibres certainly explains the irregular and branched, or even broken appearance, which the nuclei often present.

Experiment, however, demonstrates the fact that the principal, if not the only cause of these distorted nuclear forms, is merely the mechanical pressure incident to the ordinary methods of removing the intestine from the body. I find that by pulling off the head segment and then carefully separating the tail segment from the next anterior one the intestine can be slipped out of the body, generally without injury, simply by pulling on the tail segment. I have prepared many such specimens which do not show a single distorted nuclear form. If now an intestine so removed be gently pressed in several spots with a blunted pencil, the distorted nuclei are found, after staining and mounting, to be located immediately around these spots. If the entire alimentary tract be gently pressed with a spatula, every nucleus may be caused to take this form. I believe, therefore, that these distorted nuclei are largely, if not entirely, the result of mechanical pressure produced by contact with foreign objects. Whether cells which have undergone such pressure may afterwards restore their nuclei to a normal condition, or regain them, if altogether lost, is a question which I am now investigating.

In some cases in which the intestine was removed with the most pains-taking care a few cells were found in which a normal looking nucleus extending into two cells, Fig. 8. Some of these cases, I am convinced, are amitotic divisions of the nucleus; *e. g.* figures 7 and 8 show cells which are indented on the cœlomic side and in which the nuclei are dumb-bell shaped. That this is not a case of "conjugation" is evidenced not only by the shape of the cells but also by their size, for they are scarcely any larger than single neighboring cells. On the other hand there are many cases in which nuclear forms which might be mistaken for amitotic division figures are plainly proclaimed to be squeezed nuclei by the absence of a nuclear membrane from one end, Fig. 3.

There remains to be described the remarkable structure of some cells which, I believe, are entirely normal. In the anterior region of the alimentary canal the luminal side of each cell is covered by a very thick coat of chitin. Through this chitin run a great many minute channels which unite to form larger channels and ultimately open into the cell. The space into which they open is filled with a homogeneous, non-granular substance which stains an intense black in iron hæmatoxylin. This substance is limited to the space lying between the nucleus on the one side and the chitinous wall on the other and it evidently fills the channels which penetrate this wall. Its appearance is very different from ordinary cytoplasm and I believe it is a form of secretion which is being elaborated by the cell to be poured through the channels mentioned into the alimentary canal. The proximity of the nucleus to this substance, as well as the aggregation of the chromatin on the side of the nucleus next to it, suggests that the nucleus must play an important role in its formation; the nuclear membrane, however, is intact on all sides.

In that portion of the intestinal wall on the ventral side immediately posterior to the well developed typhlosole the nuclear membrane is in all cases excessively thin on the side of the cell next the lumen, and it is usually drawn out into finely pointed processes which become continuous with the cyto-reticulum. In several cases which I have observed the nuclear membrane is altogether wanting on this side of the nucleus, and in such cases it can be readily seen that the cyto-reticulum is continued into the nucleus, while the chromatin granules, which are densest toward the middle of the nucleus, become directly continuous with the large microsomes of the cytoplasmic net. This transition of chromatin granules into microsomes is most beautifully shown when a differential stain such as the Biondi-Heidenhain mixture is used. In such cases the chromatin granules within the nucleus are green, the microsomes are red, and between these the granules shade from one into the other through various tints of blue and lilac. It is of course possible that in this case the nuclear membrane may be ruptured owing to pressure. Against this view, however, may be urged the fact that the disappearance of the membrane always occurs at one point, viz. on the side next the lumen and furthermore there is no evidence of rupture, the *structures* of the cytoplasm being continued without interruption into those of the nucleus. I hold, therefore, that these cells normally show a direct continuity between cytoplasmic and nuclear structures, though I cannot at present explain the functional significance of this fact.

Finally in the cells of the dorsal wall posterior to the typhlosole the nucleus is deeply indented in certain cases on the side next the lumen, the chromatin is massed on the opposite side and the nucleus is very large and vesicular containing many irregular dark-staining masses or nucleoli, which are frequently vacuolated. On the luminal side the nuclear membrane becomes so thin that it is impossible to say whether it is continuous or not. Between the nucleus and lumen the cytoplasm is unusually dense and immediately outside of the nucleus it is massed into a dense darkly-staining substance, which projects by one or many processes into the cavity of the nucleus. These processes frequently contain vacuoles and in structure and staining qualities they exactly resemble the nucleoli. Frequently these processes are deeply constricted at the base as if they were about to be cut off and set free into the nuclear cavity, as indeed I believe to be the case.

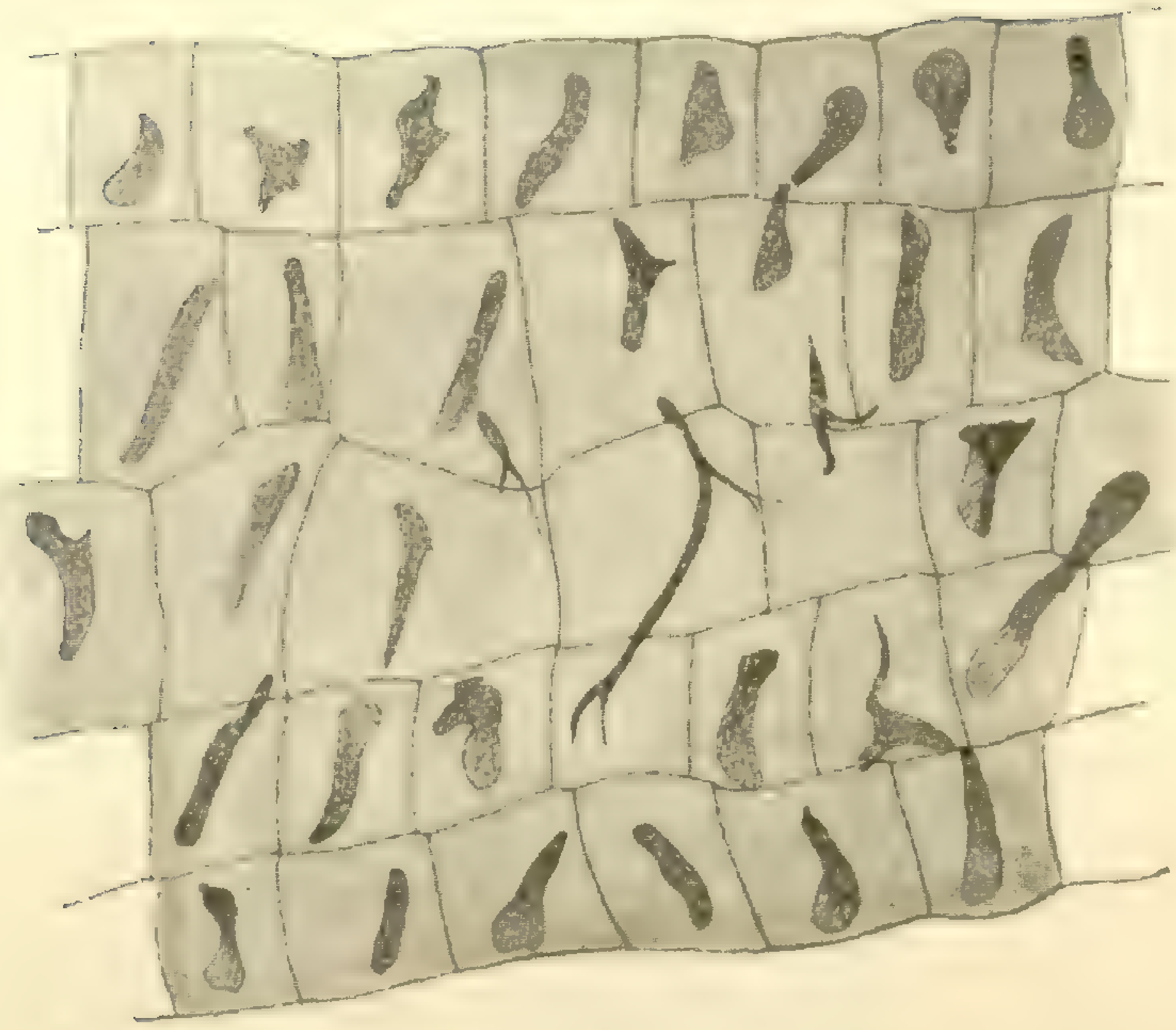
The general similarity of this process to the reception of food material by the egg of *Dytiscus* as observed by Korschelt is at once apparent. In this case, as in that, there is little doubt that the granular material is a nutritive substance, which, in the case of the Isopods, is taken up from the alimentary canal and sent up in a broad band to the nucleus, where it aggregates immediately outside the nuclear wall. Unlike the cases observed by Korschelt; however, this substance projects into the vesicular nucleus in the form of processes which appear to be cut off and set free within the nucleus. There are many reasons for believing that this substance projects into the nucleus rather than that the nucleus sends out pseudopodial processes into it. The nuclear wall is at this place so extremely thin as to be absolutely invisible in many places, and the nucleus itself is of such an open and vesicular character that it seems scarcely possible that it should actively send out processes into this densely granular mass. Moreover the evidence that these processes are set free into the nuclear cavity seems to me very good, though, perhaps, not absolutely convincing. I shall leave the consideration of the functional significance of this phenomenon to a future paper.

Description of Figures.

Fig. 1. A small portion of the intestinal wall of Porcellio which had been gently pressed upon with a spatula. The entire intestine was similar to the bit here shown. Fixation, Corrosive-Acetic; stain, Biondi-Heidenhain; Obj. 8mm.; Occ. 4 (all the figures were sketched with a camera lucida under Zeiss Apochromatic lenses).

Fig. 2. Longitudinal section through dorsal wall posterior to typhlosole showing distorted nuclei. The contiguous cell boundaries are marked only by the circular muscle fibres which are seen in cross-section. Fixation, picro-formalin; stain, Biondi-Heidenhain; Obj. 3 mm.; Occ. 4.

PLATE II.



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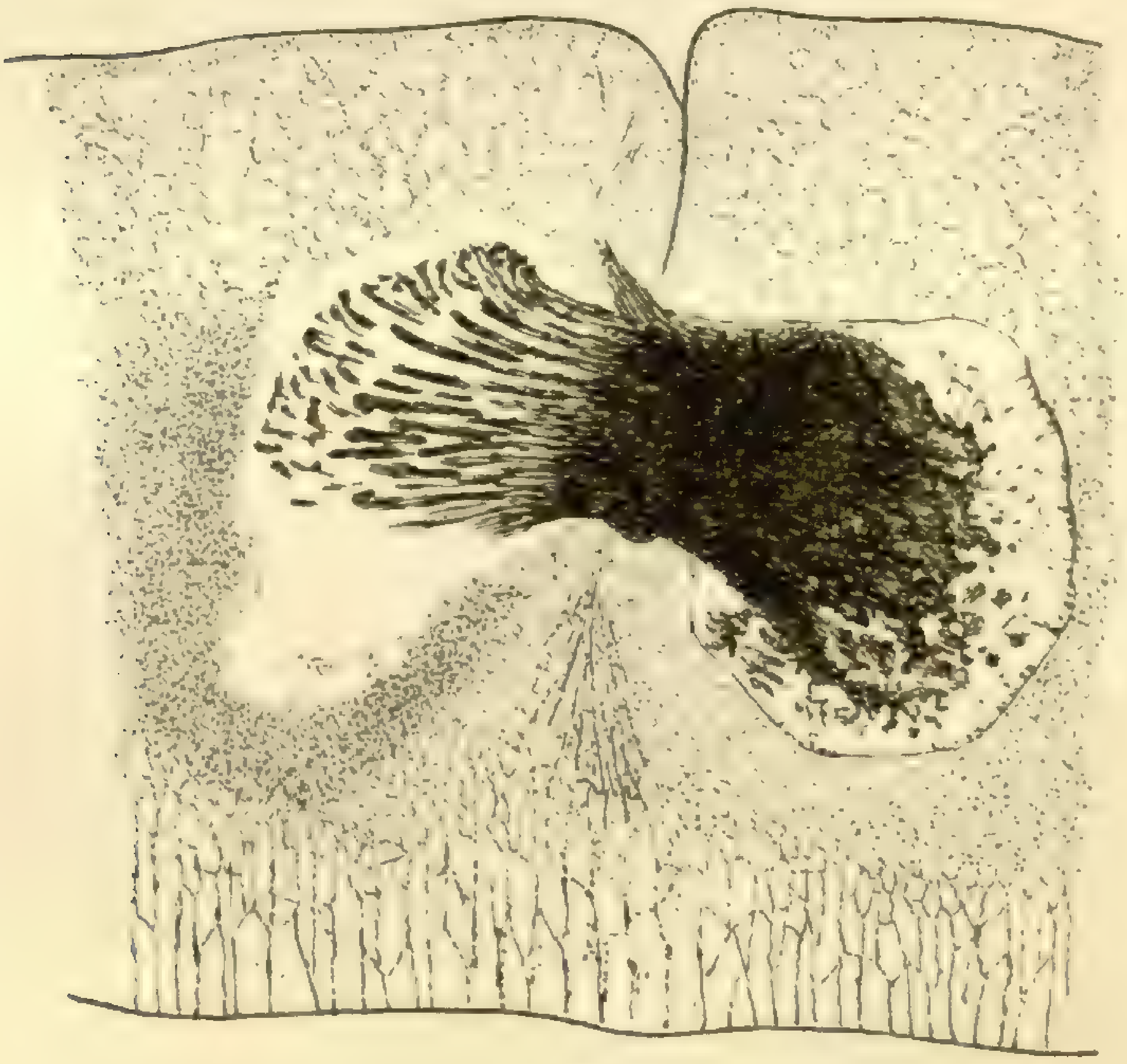

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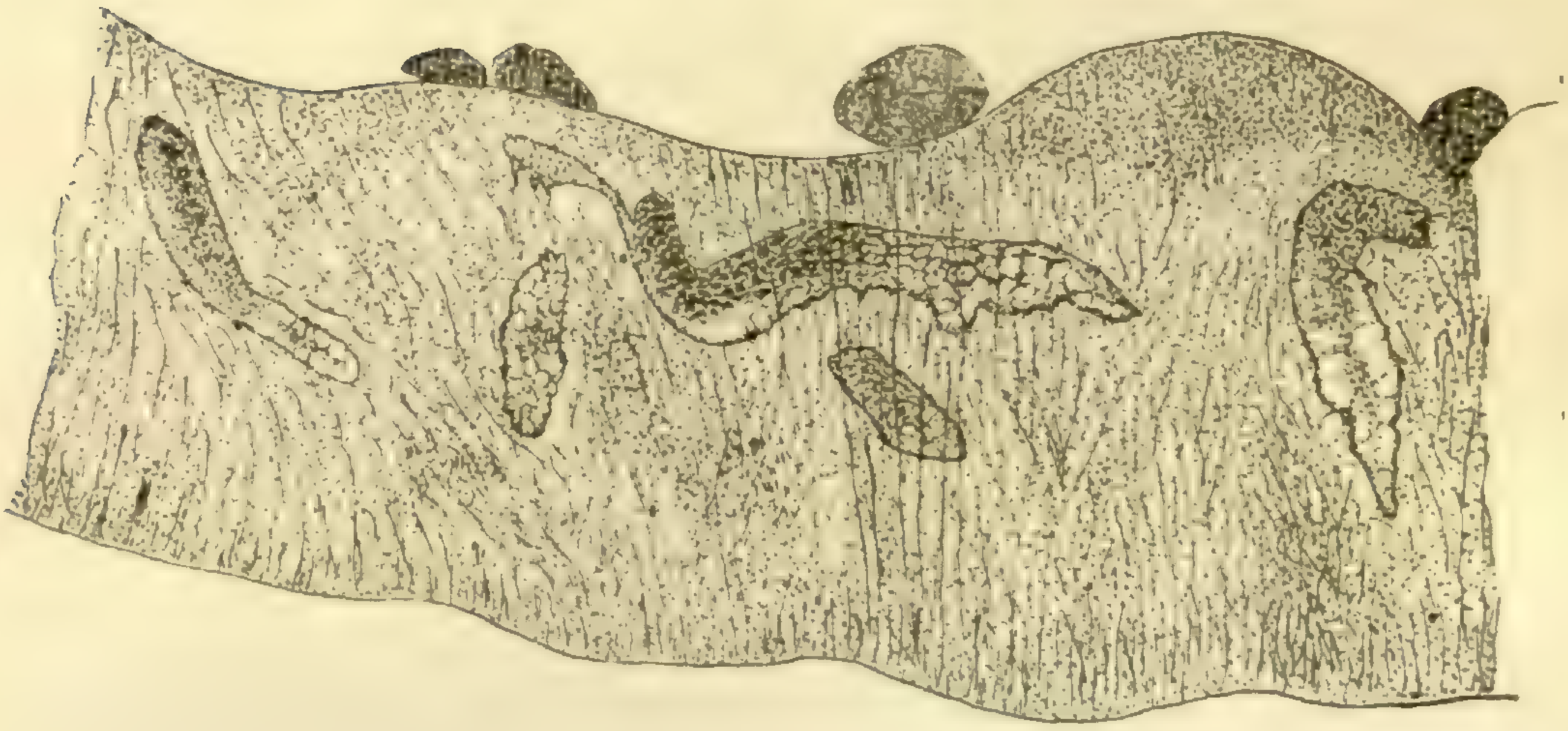
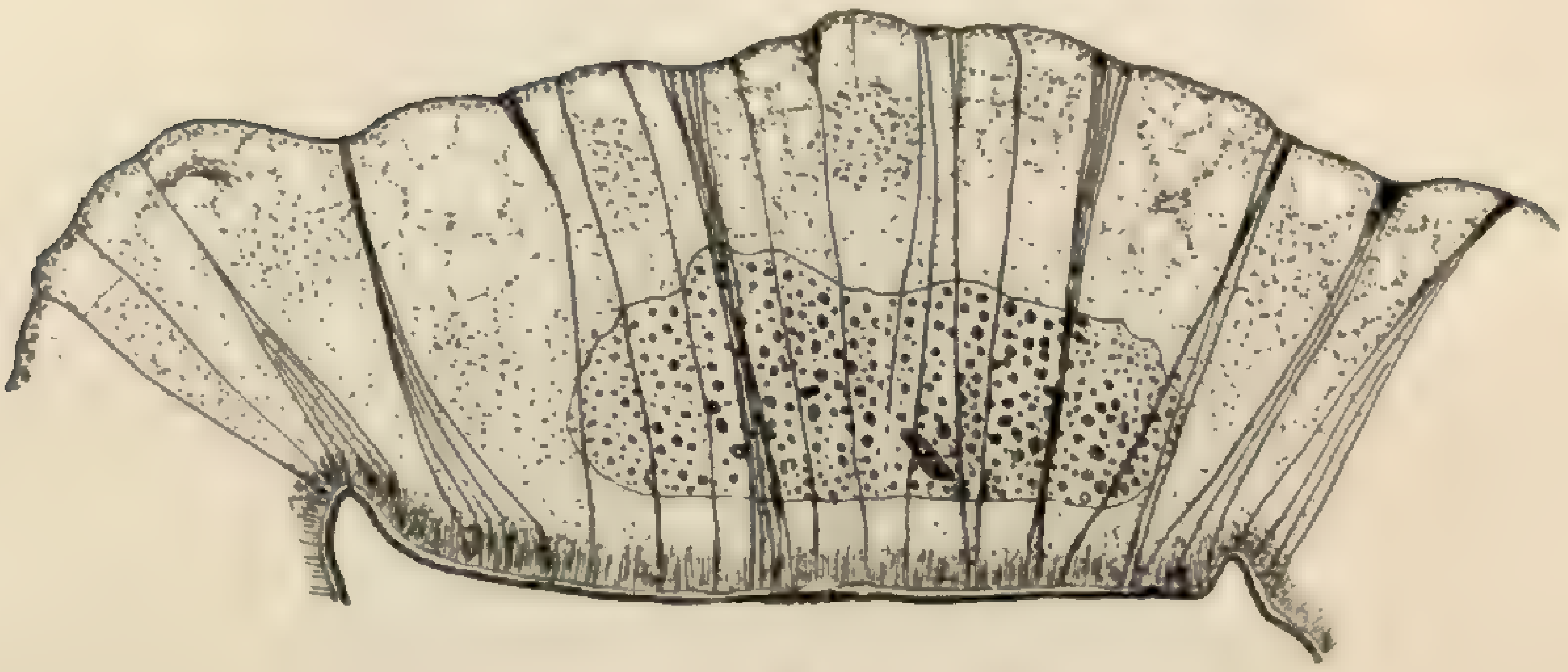


Conklin on Isopoda.

PLATE III.



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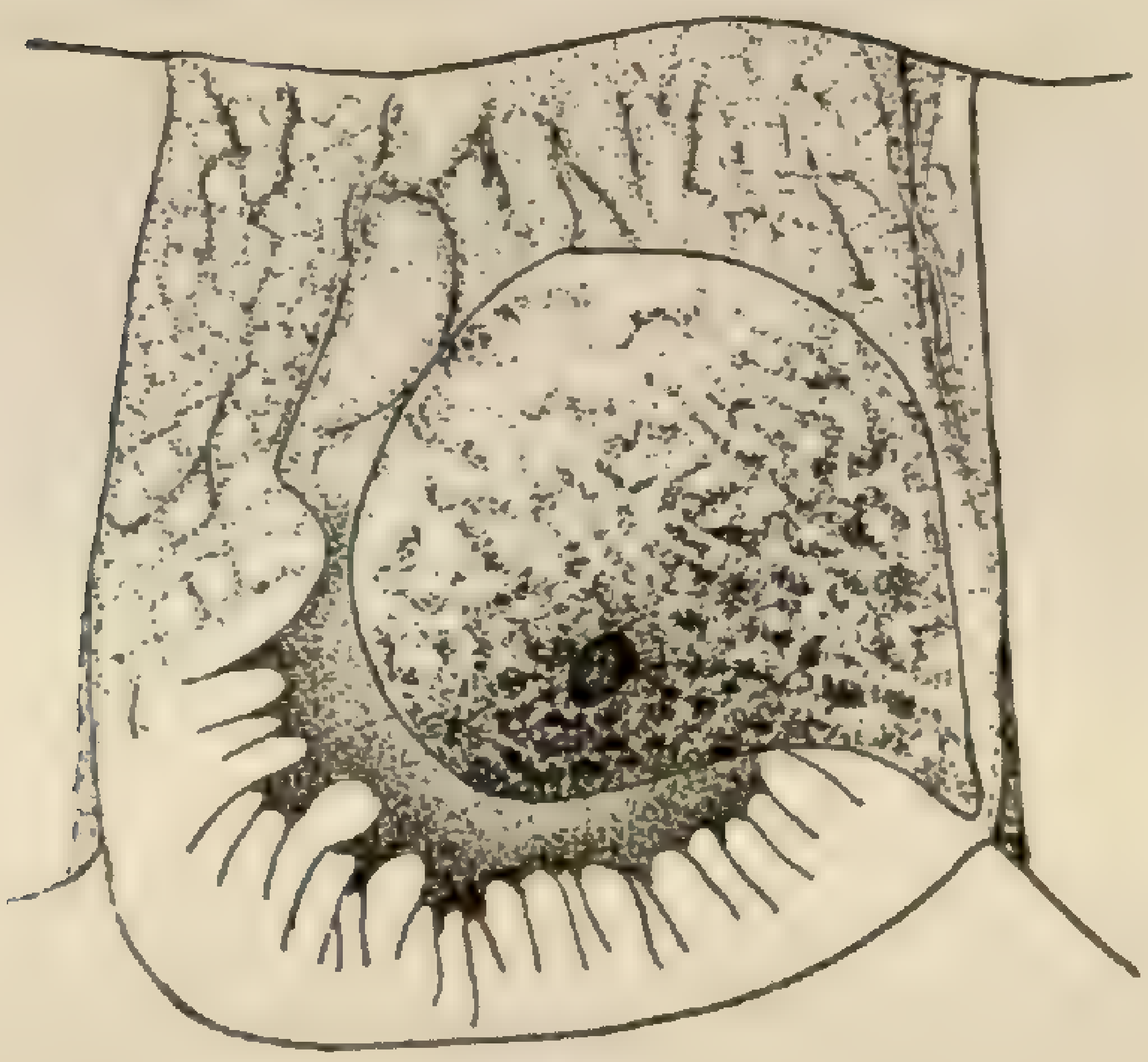

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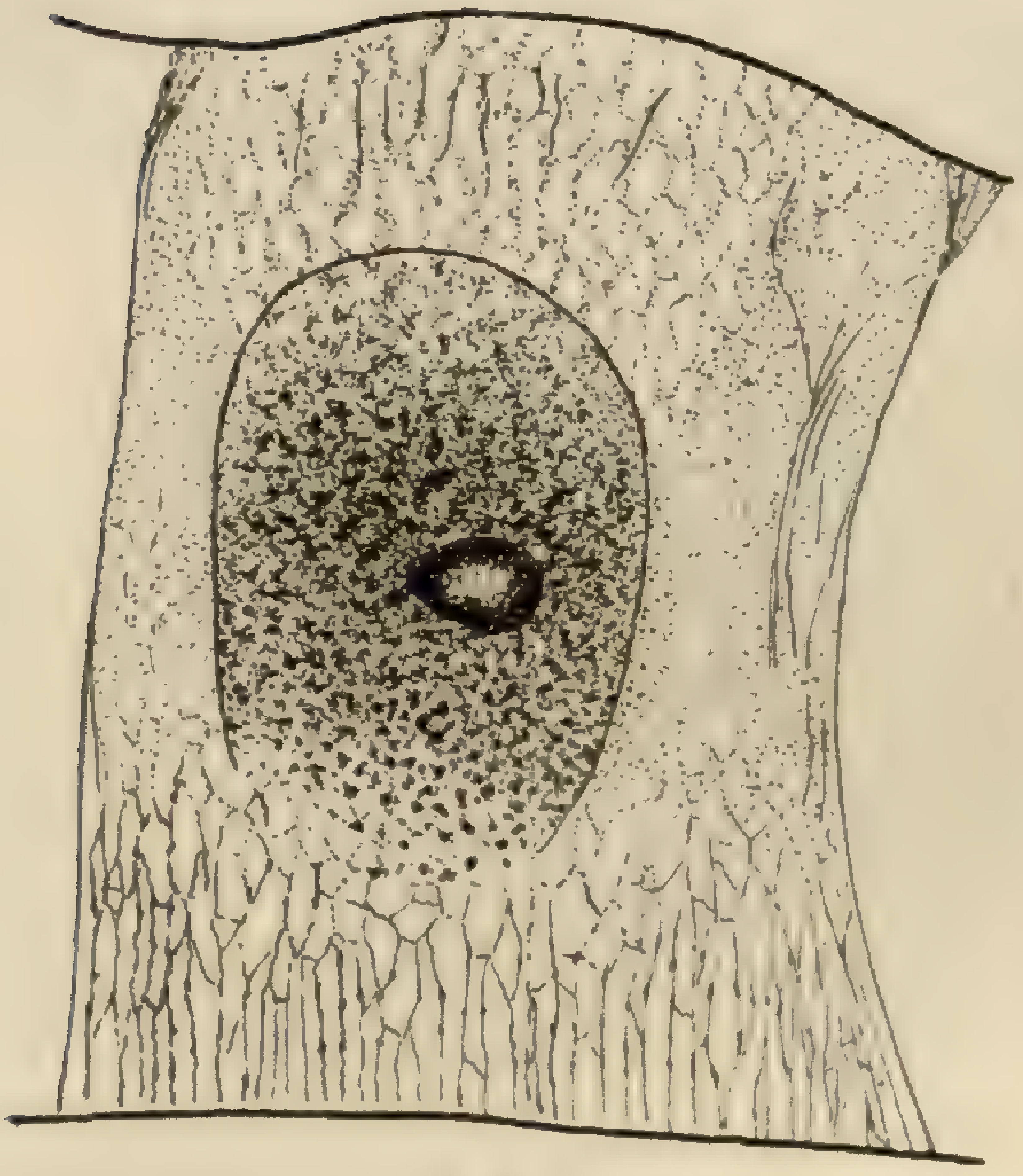

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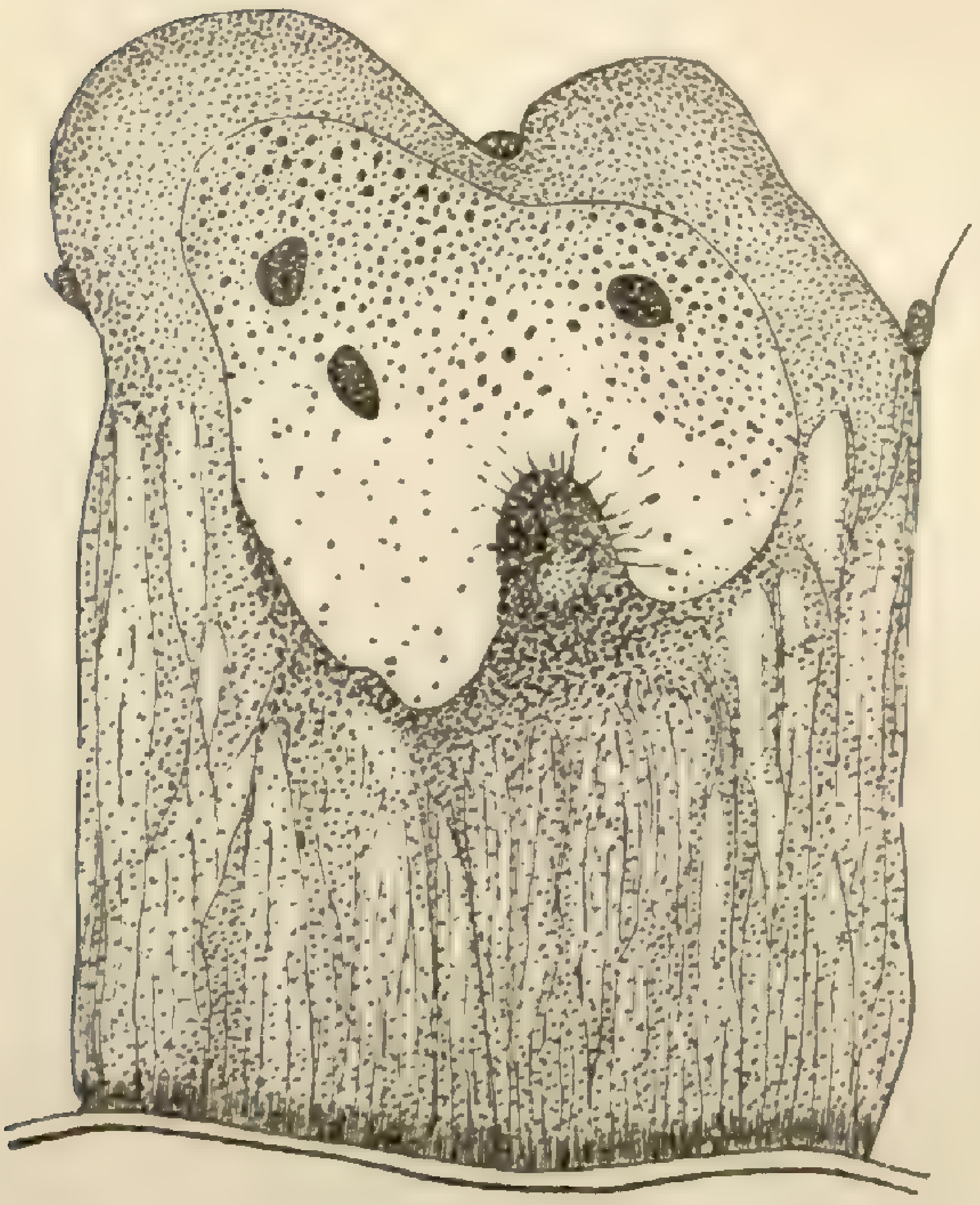
Conklin on Isopoda.

PLATE IV.



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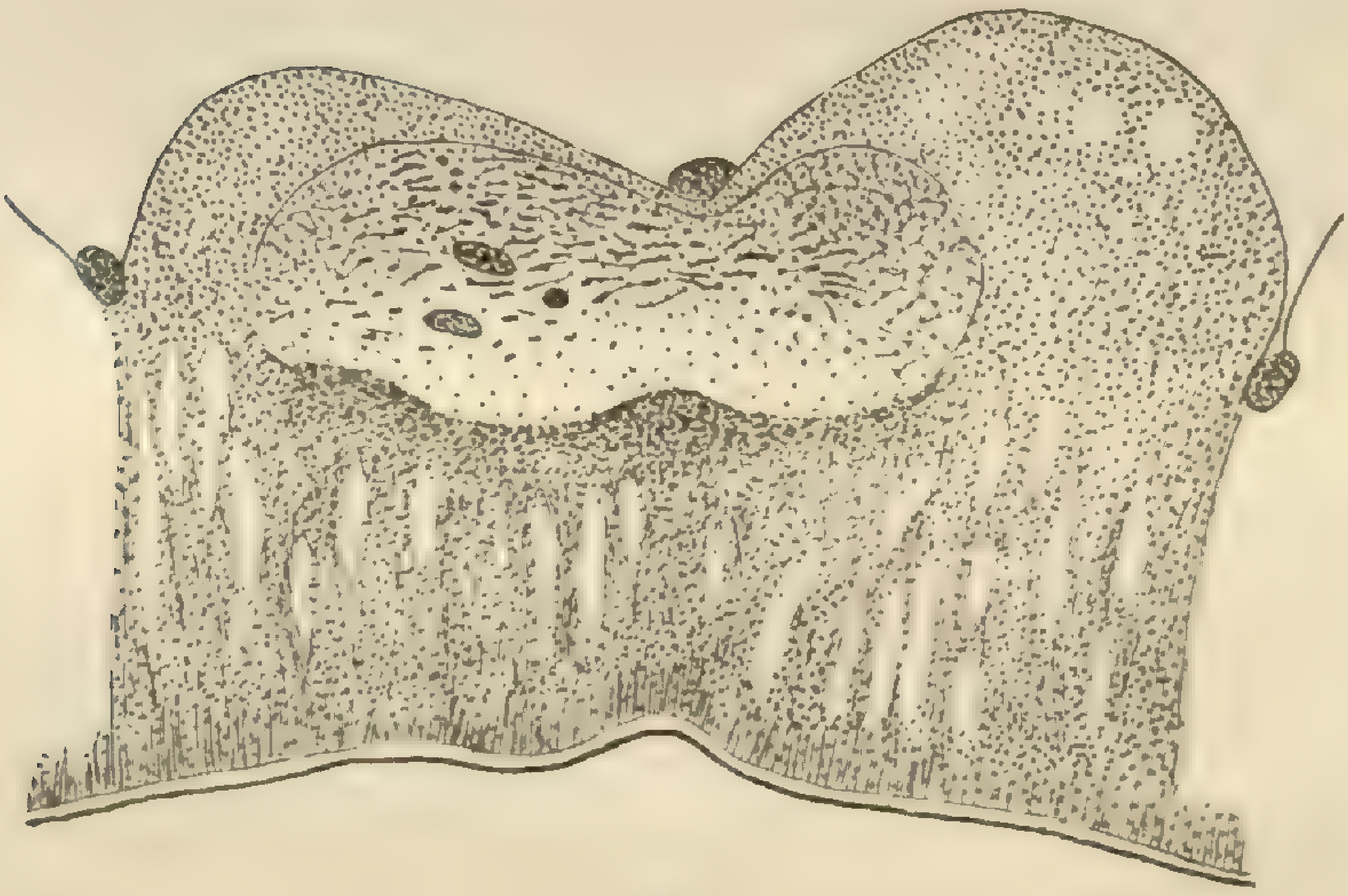

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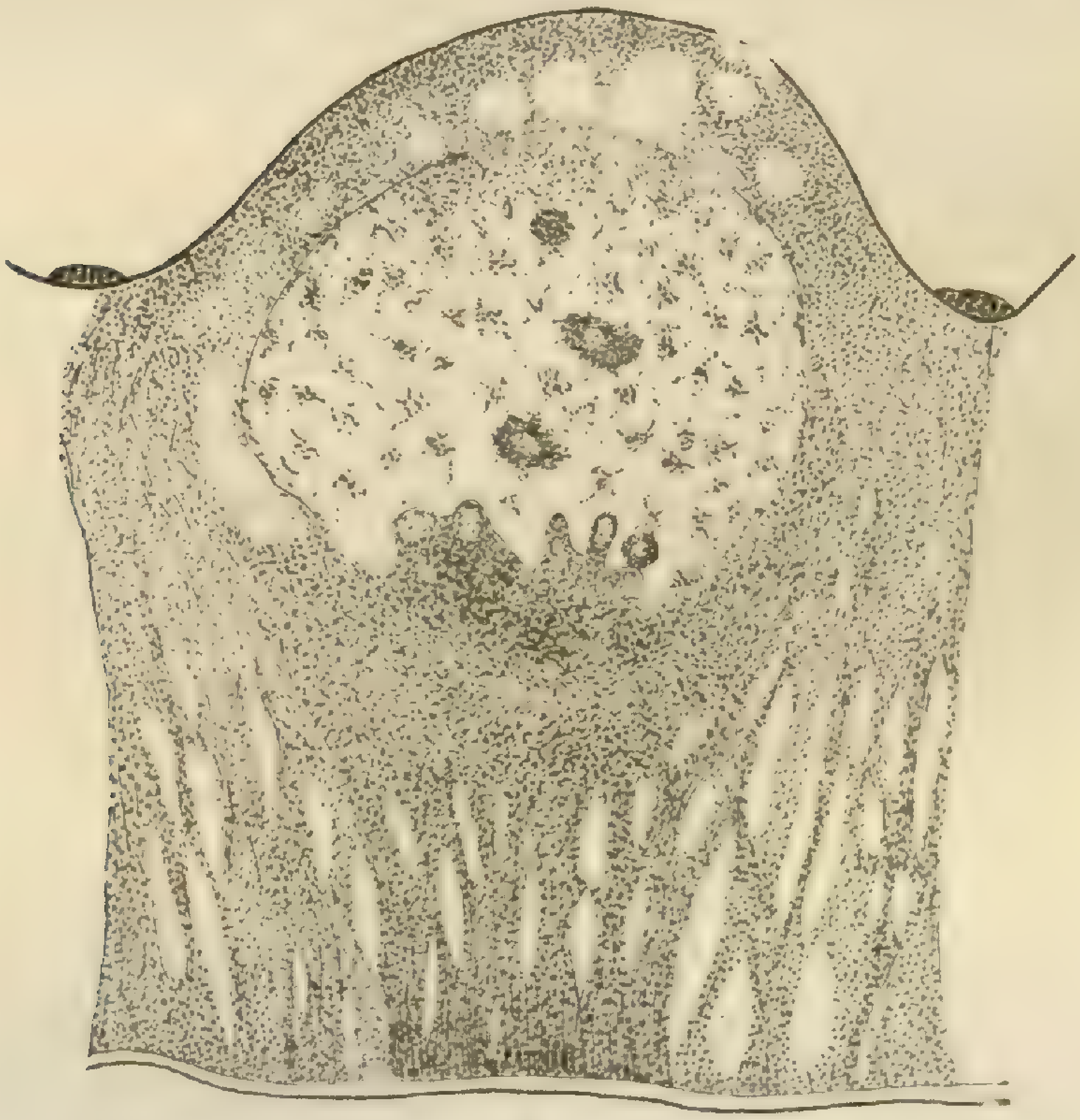

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Conklin on Isopoda.

Fig. 3. Cell from ventral wall near anus showing nuclear substance which has been forced from right to left in the figure. Fixation, Hermann's fluid; stain, iron haematoxylin; Obj. 3 mm.; Occ. 12.

Fig. 4. Section of elongated cell at dorsal margin of typhlosole showing fibres which traverse the cell. No lateral cell walls visible. The chitinous lining of alimentary canal is shown in double contour. Fixation, Flemming's fluid; stain, iron haematoxylin; Obj. 3 mm.; Occ. 12.

Fig. 5. Cell from region of typhlosole, dorsal side, showing the very thick chitinous wall (unshaded) which is perforated by many minute canals. Nucleus slightly distorted. Fixation, Hermann's fluid; stain, iron haematoxylin; Obj. 3 mm.; Occ. 12.

Fig. 6. Cell from ventral side posterior to typhlosole showing continuity of nuclear and cytoplasmic structures. The cyto-reticulum is very strongly marked on the side of the cell next the lumen. Fixation, Hermann's fluid; stain, iron haematoxylin; Obj. 3 mm.; Occ. 12.

Fig. 7. Cell from dorsal wall posterior to typhlosole showing an indentation on the coelomic side which is probably the beginning of cell division; the circular muscles are shown in cross section. A densely granular process of nutritive substance projects into the nucleus on its luminal side. Fixation, corrosive sublimate; stain, Biondi-Heidenhain; Obj. 3 mm.; Occ. 12.

Fig. 8. Cell from same region as preceeding figure, showing later stage of amitosis. Fixation, stain and magnification same as Fig. 7.

Fig. 9. Cell from same region as Figs. 7 and 8. Nutritive substance projects by many processes into nucleus, some of which contain vacuoles and are apparently being set free into nucleus to form nucleoli. Fixation, stain and magnification same as preceeding figure.

E. G. Conklin, University of Pennsylvania.

Myriapoda Climbing Vertical Glass Surfaces.—Dr. C. Verhoeff has been making experiments upon the climbing powers of *Polyxenus* and of juloid diplopods. His results show that unless the surface is such or is covered with some substance that gives a purchase to their claws the diplopods have not the power of climbing in the true sense of the word. They are only able to reach up the sides of a glass dish by using the last few segments of their body as a base of support. On the other hand the Polyxenids can climb. This fact, it may be noted, is patent to every one who has collected and kept them alive in a vial. They are invariably found in the neighborhood of the cork, ready to escape as each new one is put in. And it may be added that the pauropods can climb, though scarcely as well as *Polyxenus*. But what they lack in the power to climb clean, dry glass surfaces may, perhaps, be accounted for by the fact that these little fellows, dependent as they are upon respiration through a delicate cuticle, quickly succumb to dryness. I have watched individuals of both *Pauropus* and *Europauropus* as they ran up the sides of a vial or of a crystallizing dish, going easily where the surface was covered by fine particles of earth or humrus, and falling off where the surface seemed clean.—F. C. KENYON.

Lepidosiren articulata Not Distinct from L. paradoxa.[2]—Prof. E. Ray Lankester has lately made a study of the limbs of the various specimens of *Lepidosiren* conserved in the various European museums, and finds that in every case examined the skeleton of the limbs is not a continuous cartilaginous rod, but is composed of a series of articulated cartilages. This removes the difference that Ehlers supposed to exist between his specimens from Paraguay and those from the Amazon basin, and caused him to create the species *L. articulata.* To further show that the specimens from the two river systems are in all probability of the same species *L. paradoxa*, Prof. Lankester compared the specimens in head-length units, with the following result, which shows differences of no specific importance.

Brazilian, average: total length, 9.87; inter-membral, 5.25; post-membral, 3.5; cervico-dorsal, 3.21.

Paraguayan, average: total length, 9.75; inter-membral, 5.21; post-membral, 3.59; cervico-dorsal, 3.2.—F. C. KENYON.

The Regeneration of the Lens in the Eye of Triton.—Some two years ago we were astounded by the contents of a brief communication by Gustav Wolff in the Biologischen Centralblatte[3] bearing the title, "Remarks on Darwinism, with an experimental contribution to the Physiology of Development." In this the author brought forth the results of an experiment that flatly contradict one of the chief tenets of Weismann, inasmuch as he showed that the destruction of an organ formed from the ectodermic layer is followed by a regeneration of the structure from a layer of cells of mesodermal origin. In other words, the lens of the eye of *Triton tæniatus*, when destroyed, is reproduced by a lens that develops from the iris! Later on, Wolff published his final paper with illustrations.[4] But the work was in great need of confirmation. This has been done by Erick Müller,[5] who seems to have begun his task with as much skepticism as might be expected.

[2] Trans. Zool. Soc., XIV., 11–24.

[3] Bd., XIV (1894), No. 17.

[4] Arch. f. Entwicklungsmechanik d. Organismen, I, 1895.

[5] Arch. f. mikr. Anat, xlvii (1896), 23–34.

The larvæ chosen varied from 3–6 cm in length. Each was held in a damp cloth to avoid injury, the cornea carefully slit with a scalpel and the lens removed without injuring the iris. Within one day changes were noted in the layer of cells composing the latter. The inner layer began to take on the appearance of embryonic cells. The cells began to loose their pigment, which was taken up and carried off by the leucocytes that began to fill the pupillar space. Then they began to increase in size and by the tenth day a small group of them, recognizable as a small swelling in the accompanying figure, copied in outline from the author's figure, had been pushed into the pupillar space. From this time on, the group of cells underwent all the changes recognizable in the normally developing lens. The posterior layer became much thicker than the anterior; its cells became more or less columnar and finally arranged themselves in concentric layers covered as a whole by the outer one-celled layer. By the fortieth day after the operation, the inner cells forming the inner three-fifths of the lens had lost their nuclei and become transparent. By the sixtieth day the regenerated lens had every appearance of a normal one.

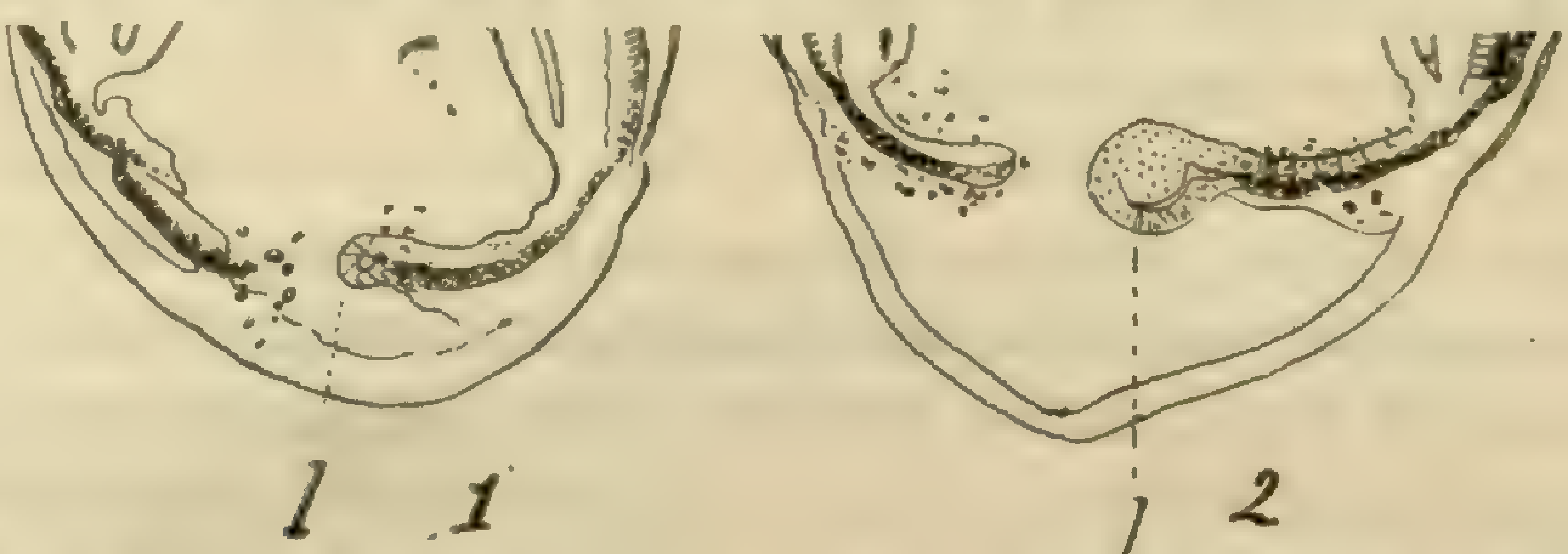

Fig. 1. 10 days after the destruction of the lens; showing the new lens, *l*, regenerating from the iris. Fig. 2, 18, days after the operation.

The changes were followed through from day to day and, as shown by the fifteen figures given by the author, seem conclusive.—F. C. Kenyon.

The English Sparrow not Always a Nuisance.—It is gratifying to run across direct evidence that that feathered nuisance of our large cities, the English sparrow, does a little real good, after all that may be said against him. According to a late communication by S. D. Judd in the Auk, this sparrow has a fondness for the seeds of the common dandelion. Of all the seed-heads of this plant collected from a space of ground six feet in diameter, one hundred and thirty-five showed traces of the bird's beak.

The same author says that he has seen an English sparrow chase through the air, catch and devour a cicada. Catching insects that fly in a direct line does not seem to be a very difficult matter, but others able, like the dragon fly and flies generally, to dodge, as well as others of a naturally uncertain course, nearly if not always elude the bird's bill.

He also reports that the sparrow is very fond of picking up the insects injured or killed by the electric lights.—F. C. K.

The Origin of the Chiropterygium.—It has been said that the limb of the higher Vertebrates—Man, Reptile, Batrachian—does not exhibit the rayed structure of fishes. To explain this condition M. Mollier offers four possible solutions.

1. A single ray may have persisted and present segmentation is a secondary formation, all the other rays having degenerated.

2. Two rays only may have been preserved. Traces of these two rays would then be found in the forearm. The five fingers would be a secondary division, while a fusion of two rays would take place in the region of the humerus.

3. Five primitive segments might be represented, indicated both by the number of nerves together with the muscular buds, and by the number of the fingers.

4. The number of rays might be indefinite; they united to form a single mass, which ulteriorly underwent a secondary segmentation.

To the first hypothesis is opposed the fact that concentration is everywhere the rule, while this supposition would necessitate that the primitive outline, which had started from at least two segments, must enlarge.

As to the second hypothesis, embryology shows that the two bones of the fore arm develop from a single mass.

The third hypothesis rests on several concurrent conditions. But we find, according to M. Mollier, that the number five is not constant. Among the Batrachians, there are only three.

The only plausible theory then, is the fourth which agrees with all the facts of embryology which Mollier therefor accepts. (Revue Scientif. Sept., 1895, p. 340.)

A New White-footed Mouse from British Columbia.—During a collection trip in the northwest, Mr. Will C. Colt made several excursions to Saturna Island (in the Gulf of Georgia half-way between Victoria and Vancouver City), British Columbia, and secured there over two hundred white-footed mice. This enormous series, now in the Bangs collection, taken in January, February, March, April and May, 1894, represents a strongly marked and hitherto undescribed subspecies of *Peromyscus texanus*. The same form is probably found on all the islands and coasts of this vicinity, and agrees in its dark coloration with the whole fauna of this saturated region.

Through the kindness of Dr. C. Hart Merriam, I have been able to compare the Saturna Island series with a series of *P. taxanus gambellii,* belonging to the collection of the Department of Agriculture, from the type locality, Monterey, California. I have also made comparison with a large amount of material from Nicasio, California. Specimens from the latter place agree very closely with specimens from Monterey. The Saturna Island form is the darkest colored member of the *texanus* group, and is readily distinguished from either of its two nearest allies, *P. texanus gambellii* and *P. texanus arcticus,* by the peculiar sooty black of its upper parts. The new form may stand as:

PEROMYSCUS TEXANUS SATURATUS subsp. nov. *Type* from Saturna Island, B. C., No. 2581 ♂ old adult, coll. of E. A. and O. Bangs. Collected by Will C. Colt, January 31, 1894. Total length 190; tail vertebræ 94.5.

General Characters.—Size and proportion about as in *P. taxanus gambelli,* from which form it differs in being very much darker in color; the general tone of the upper parts sooty-black instead of yellowish-brown.

Color.—Upper parts sepia-brown, much intermixed with sooty-black, most intense on face and middle of back, paling off on sides; a narrow and indistinct band of cinnamon along lower sides; under parts grayish-white, the hairs deep plubeous basially; a black orbital ring; ears black, narrowly-edged with white; tail quite hairy, sharply bicolored, black above, white below; feet and hands white.

Size.—Average measurements of ten old adult specimens: total length 180.95; tail vertebræ 76.20; hind foot (from dried skin) 21.25.

Remarks.—*P. texanus saturatus* has a short tail, shorter than the head and body, and this character will always serve to distinguish it from any of the long-tailed mice with which it might be found, such as *P. austerus, P. macrorhinus* and *P. keenii,* all these having the tail longer than the head and body.—OUTRAM BANGS.

Some Bats from Lower California.—A small collection of mammals made by Mr. A. W. Anthony at San Fernando, Lower California, during April, May and June, 1894, includes four species of bats. All of these are interesting, on account of the locality at which they were taken, while one, an addition to the 'North American' fauna, is very slightly known.

In a paper on the birds of San Fernando (Auk, XII, April, 1895, p. 134) Mr. Anthony has given a detailed account of his collecting ground. "The region," he writes, "* * * has for its center the old abandoned copper mines of San Fernando, one league south of the ex-mission of the same name which is situated about twenty-five miles from the Pacific coast of the peninsula in about latitude 29° 30′. It has an approximate altitude of fifteen hundred feet above sea level, and is the center of one of the most barren of the Lower California deserts." Such a locality could not be expected to furnish a very extensive bat fauna. Hence the collector's notes on the habits of the animals under conditions apparently so unfavorable are of such value that they may be quoted entire for each species.

CHÆRONYCTERIS MEXICANA (Tschudi).—Mr. Anthony secured ten specimens of this species in the shafts of the abandoned mines. Southern Mexico has hitherto been the northern limit of the known range of this bat, which now finds a place in the fauna of 'North America.' The ten specimens, all but two of which are adults, measure as follows:

Number,	3240	3241	3242	3243	3244	3245	3246	3247	3248	3249
Sex,	♂	♀	♂	♂	♀	♀	♀	♀	♂	♀
Total length,	77	79	73	75	77	56	65	72	75	72
Tail vertebræ,	9 8	8	9.6		9	6	7.6	8.6	9	8.4
Free part of tail,	1.8	1.8	1.4		2	0.8	1	1.4	1	2
L. of interfemoral membrane from base of tail,	18	16	18		16	12	15	16.4	16	15
Occiput to tip of nose,	32	32.4	33		32	26	28.6	32	30	32
Nose leaf: height,	5.4	5	5		5.4	3.8	4	5	4.2	4
Nose leaf: width,	4.8	4.6	4.4		4.4	3.4	3.4	4.8	4	4
Ear from meatus,	17	16.2	14.8		14.4	14	14	15	16	15
Ear from crown,	10.8	11	10.4	10	10	8	9.2	10	10	10
Tragus: height,	6.4	6	5		5	5	4	5	5	6.2
Tragus: width,	2.8	2.4	2.4		2.4	2	2	2	2 6	2.8
Forearm,	44	40	43.6	43	44	38	43	43	40	43
First digit,	10	8	8		8.8	10	9	9.8	8	10
Second digit,	40	38	36		37.4	28	35	87	36	37.6
Third digit: metacarpal,	41.4	42.6	38	35.6	41	29	38	41	40	41
first phalanx,	17	17	16.6	16.5	17.4	12.6	16	16	16.4	17
second phalanx,	21.4	22	19	21.6	21.4	15	19	21	20.6	20
third phalanx,	10.4	10.6	11	11.4	11	8.4	10.4	11	12	11.8
Fourth digit: metacarpal,	38	39	36	37.6	39	27	34	37	37	36
first phalanx,	12	12	11	10.6	12	9.4	11	11.6	11.8	11.4
second phalanx,	15	15.4	14	13.9	14.6	11	14	15	14	14
Fifth digit: metacarpal,	37	38	36	36.8	37	28	34	36	35	36.4
first phalanx,	10	10	10	9.6	10.4	8.8	10	10	9.4	10
second phalanx,	13	14	12	12.7	13	10	12	12	13	12.4

"This bat I never saw flying about in the evening. One came into my cabin one night about 9.30, but with this exception, I never saw one outside of the shafts and tunnels of the mines. Here they were fairly common and usually found near the mouth of the opening—frequently where the sun could reach them at some hour of the day. When disturbed during the day, they usually took to the open air, and either sought shelter in one of the old buildings about the shaft, or flew into one of the abandoned shafts near by. They showed a marked preference for the light, but if pursued took to the lower levels and for a number of days did not venture from that Stygian darkness that *Vespertilio*[6] seemed to prefer. In flight they were quick and strong—more so than any other bat I have met with. I think they seemed to see well even in bright sunlight, and were by no means easy to secure after being driven from the mine.

"In fresh specimens the tongue is very similar to that of *Dryobates,* being extensible for at least an inch and a half and also barbed, though of course the barbs are soft."

ANTROZOUS PALLIDUS (Le Conte).—Five specimens.

"The large, pale bat I only took in the cabin. They frequently came in through the open door and were secured with a shingle."

VESPERTILIO NITIDUS H. Allen. Three specimens. As Mr. Anthony did not distinguish between the species of *Vespertilio* and *Vesperugo* in his collection it is probable that his notes refer in greater part to the latter.

"*Vespertilio* is the only bat I saw during the evening. They usually came out early, but owing to their habit of flying through the brush very low (3–6 ft. above the ground) they were hard to shoot. During June I found them catching insects about the tops of the cardones and shot several. One was found under a plank where it had crawled to spend the day. They were common in the mine, seeking the deeper levels where it was very dark, in marked contrast to the leaf-nose [*Chœronycteris*] the only other species found under ground."

VESPERUGO HESPERUS H. Allen. Seven specimens which the collector did not distinguish from *Vespertilio nitidus.*—GERRIT S. MILLER, JR.

Deaths from Wild Mammals and Snakes in India.—From the annual report for 1895 of the government of Madras[7] one learns that 1923 persons were killed by wild mammals and snakes, and that of these, 277 cases are attributed to wild mammals and the rest, 1646, to snakes. It is possible that the deaths reported from snake bites may be due to poisoning from other sources. The deaths caused by wild mammals are shown to be:

4	from elephants.
177	from tigers.
64	from panthers or leopards.
12	from bears.
10	from wolves.

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[6] In his notes Mr. Anthony does not distingush between *Vespertilio nitidus* and *Vesperugo hesperus.*

[7] The Zoologist, September, 1896.

2 from hyenas.
8 from other mammals.

Of these deaths, 85 occurred in the district of Ganjam and 73 in Visagapatam. In Ganjam much of the destruction was due to a man-eating tiger.

The largest number of deaths from snake bites occurred in Chingleput, North Arcot, South Arcot, Tanjore, Trichinopoly and Salem, from which districts 58 per cent of the total number were reported.—F. C. K.

The Number of Living Animal Species.—For the benefit of the curious, as well as the zoological student, the following table giving the census of the animal kingdom as known in the years 1830, 1881 and 1896 is inserted. The first two columns are taken from a note by A. Günther, in Annals and Magazine of Natural History,[8] and the last from a note in The Zoologist.[9] The last was compiled in February (1896) by the contributors to The Zoological Record.

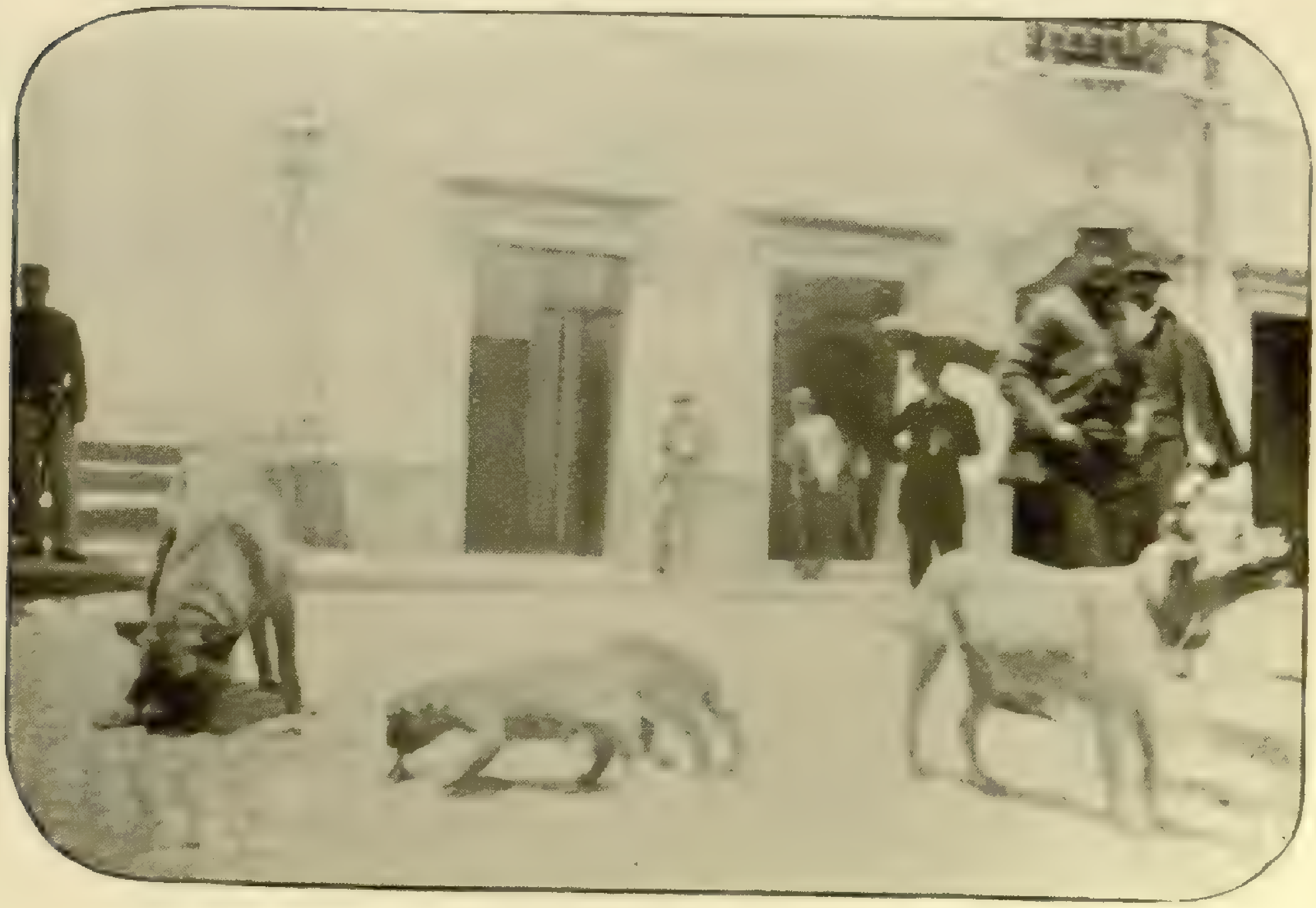
	1830	1881	1896
Mammalia,	1,200	2,300	2,500
Aves,	3,600	11,000	12,500
Reptilia,	443	2,600	4,400
Batrachians,	100	800	
Fishes,	3,500	11,000	12,000
Tunicata,	. .	. .	900
Mollusca,	11,000	33,000	50,000
Brachiapoda,	. .	. .	150
Bryozoa,	. .	. .	1,800
Crustacea, 1840	1,290	7,500	20,000
Arachnida,	1,400	8,000	10,000
Pycnogonida,	8	70	
Myriapoda,	450	1,300	3,000
Protracheata,	. .	. .	
Hexapoda,	49,100	220,150	230,000
Vermes,	412	6,090	6,150
Echinodermata,	230	1,843	3,000
Cœlenterata, 1834	500	2,200	2,000
Spongiæ, 1835	50	400	1,500
Protozoa,	305	3,300	6,100
	71,588	311,553	366,000

It may be noted that among the mollusca, the tunicates, brachiopods and bryozoa were probably included in the 11,000 and 33,000 of the first

[8] XVII, 180.

[9] Aug., 1896.

PLATE V.



The Terceira Dog.

two dates. The dates 1840, 1834, 1835, are the earliest at which the enumeration of the groups opposite them was made. Of course the sum 366,000 will not be recognized as complete by the student of faünistics, who will claim that many valid species have been described that are not mentioned in the Zoological Record, and if we take estimates into consideration, it may be noted that the late Dr. C. V. Riley estimated that 10,000,000 would not be too great a number to represent the probably existing species of insects alone. If this be a fair estimate for the one group, insects, then, since they seem to represent about two-thirds of the whole, a reasonable estimate for the whole animal kingdom would be about 15,000,000 of species. But at the same time that this estimate is considered, it should be noted that the facts brought to light within the last few years by students of the mechanics of ontogeny and especially by such experiments as those made by Weismann and others in studying the seasonal dimorphism of of Lepidoptera indicate that very many of the species hitherto regarded as valid may be far from valid, and that descriptions of species in the future unless they are based upon a long series of experiments are apt to be much more uncertain than before.

F. C. Kenyon.

The Terceira Dog.—While many other dogs of various breeds are seen in Terceira, the yellowish-brown bull dog, often with black face, is so abundant as to be recognized as the characteristic dog of the island. Commonly it stands some two feet high, and while often gentle is frequently very savage. It is said that those intended for watch dogs are trained to jump at a hat held in the hand, in this way learning to spring at a person they attack. When kept chained, and not fondled, they will attack any person approaching, even refusing to recognize their master at night in many cases.

Usually the ears are trimmed round, and the short, deformed tail is docked to a stub, so that these marks are almost as characteristic as those which are hereditary.

Occasionally a dog of this breed is seen on the other islands, Madeira, or the continent, but all that I have ever seen were originally derived from Terceira, and are called Terceira dogs by the Portuguese. The group of these dogs accompanying (Plate V), I owe to Mr. A. E. Cady, of Providence. The single animal I took with a Kodak on a ship in the islands.—Wm. Trelease.

ENTOMOLOGY.[1]

Antennæ of Lepidoptera.—Mr. Donaldson Bodine summarizes[2] his studies of the antennæ of Lepidoptera as follows:

1. "Muscles in the head move the scape; muscles in the scape move the pedicel; distad of the scape no muscles have been demonstrated, and the clavola is, therefore, capable of motion in itself only when acted upon by some external force causing a flexure and a subsequent extension.

2. Besides organs for protection there are at least six types of sense organs situated in the antennæ, and all but one are developed from a simple sense-hair, inserted at the ectal end of a pore canal through which it is connected with a multinuclear sense-cell.

3. The antennæ doubtless function as sense organs of touch, smell and hearing, although those senses are not subject to the same limitations as in the higher animals and may be considerably different in their range of perception.

4. The antennæ show that all Lepidoptera are descended from one primitive stem form, of which we may predicate the more essential feature of structure.

5. The evolution of ventral expansions, of pectinations, of the chitinous surface, of the sense organs shows an increasing differentiation of structure following the demand for increasing specialization of function.

6. In the more essential features, the evidence of the antennæ of all the families of the Lepidoptera confirms the provisional classification based upon the wing structures, though in a number of cases it indicates a change in the relationships of the families."

Sleeping Trees of Hymenoptera.—At a recent meeting of the Entomological Society of Washington, Mr. E. A. Schwarz reported these interesting observations.[3] In Texas during April and May two species of bees, *Melissodes pygmæus* Cress. and *Cœlioxys texanus* Cress. were seen at 7.30 A. M. sleeping on dead bushes, mostly *Celtis pallida*. It is on the thinnest, outermost twigs and more particularly on the stout thorns with which this shrub is liberally provided that single sleeping specimens of these bees are found. Their position is uniform; the twig or thorn is grasped tightly with all of the six legs, and, in addition the mandibles are widely opened and with their tips firmly inserted into the wood. It requires some force comparatively speaking to dislodge the bees from their position. * * * On the very first day I found that there are certain dead shrubs which serve as sleeping quarters for a multitude of the bees. In the course of time I discovered within a short distance four shrubs (or dwarf trees) upon each of which from 50 to 70 specimens of the sleeping bees could be seen every morning, and several other shrubs which harbored a smaller number of specimens with plenty of room for more. Here my third species the Sphegid *Coloptera wrightii* comes in. It was always on the sleeping trees in company with the bees, but not so numerous as the latter. I never saw it asleep at the hour I made these observations, but the specimens were, like watchmen, slowly walking up and down the twigs, over the bodies of the sleeping bees, carefully and deliberately touching and examining with their antennæ the bees, as if trying to arouse them from their sleep. If I had been on the spot at an earlier hour I would no doubt have ascertained also the sleeping habit of the Coloptera. A well-frequented sleeping tree presents a very striking and exceedingly pretty sight, which I never wearied of observing day after day."

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[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Trans. Am. Ent. Soc., XXIII, 47.

[3] Proceedings, IV, 24.

Effectiveness of a Net in Excluding Insects.—Prof. F. Plateau has made a number of interesting experiments as to the effectiveness of a net in excluding insects, although the meshes were wide enough to allow their passage. His conclusions are: (1) A stretched net does not absolutely stop the flight of insects. (2) In their flight the insects behave as if they did not see the meshes. (3) Direct passage during flight is always rare; in most cases the insect stops and scrambles through, if at all. (4) The explanation is to be found in the lack of precision associated with compound eyes; the threads of the net, like etchings on an engraving produce the illusion of a continous closed surface.—*Journal Royal Micr. Society.*

Life-History of the Peach-tree Borer.—There is but one generation of larvæ of *Sannina exitiosa* annually. The moths appear as early as May in the latitude of Washington, D. C., and southward, over what approximates the lower austral region. In the upper austral region, roughly comprising the States above the cotton belt and below the northern tier, the moths do not appear until after the middle of June. In the transition region, which comprises the northern tier of States, together with most of New York and New England, the moths appear chiefly in July and later, emerging, however, as early as June, and belated individuals as late as October. June and July are therefore the worst months for the moths over the principal peach districts.

The egg is deposited on the bark, usually at or near the surface of the ground, although rarely it may be placed well up on the trunk or in the crotches of the larger branches. The egg is very minute, not exceeding 0.2 mm. in length, oval, yellowish-brown in color, and irregularly ornamented with hexagonal sculpturing. The young larva on hatching is very active, and immediately burrows into the bark, usually entering at cracks. Having worked its way to the sapwood, usually near or below the surface of the ground, it feeds steadily through the balance of the summer and well into the fall, constantly enlarging its excavation, and causing the exudation of the gum intermixed with excrement and fragments of bark, which is so characteristic of its presence. It remains dormant in the larval state during winter and resumes feeding again the following spring, reaching full growth in the central districts by the middle of June. It transforms to chrysalis within an elongate, cocoon-like cell constructed of its own frass and particles of bark attached with gum and threads of silk. The moths emerge very shortly after the chrysalis state is assumed, usually only a few days intervening. The males appear a few days earlier than the females.—C. L. Marlatt, *Circular No. 17, Dept. of Agriculture.*

Smith's Economic Entomology.—Professor J. B. Smith has written and the Lippincott Company has published a valuable and readable book of nearly 500 pages with abundant illustrations. Its full title "Economic Entomology for the Farmer and Fruit-grower and for Use as a Text-book in Agricultural Schools and Colleges" indicates its scope and purpose. It is divided into three parts the first devoted to the structure and classification of insects; the second to the classification and life-histories of insects, and the third to insecticides, preventives and machinery. Eight chapters are devoted to the first part, nine to the second and five to the third. The book is an admirable resumé of the present status of economic entomology, and will prove especially helpful in those agricultural colleges where the course in entomology is too short for the use of Comstock's excellent manual.—C. M. W.

Oceanic Migration of a Dragon-fly.—Robert McLachlan[4] records the taking of many specimens of the Dragon-fly *Pantala flavescens* F. on the P. and O. Steamer "Victoria" in the ocean 290 miles from

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[4] Ent. Monthly Magazine, VII, 254.

Kealing Island. "The insects were observed *at night and during heavy rain*, suggesting nocturnal migration with the possibility that they were seeking shelter from the rain, or were attracted by lights in the cabin. This power of extended migration will also account for the extension of the species over the whole intertropical zone, and far beyond it on either side."

EMBRYOLOGY.[1]

Movements of Blastomeres.—In a lengthy and detailed paper Professor Roux[2] gives the results of certain experiments upon the isolated cells of the morulas and young gastrulas of the frog. In previous papers he had shown that when the cells are teased apart in solutions of salt or of white of egg they may move together again, traversing short distances without any apparent means. He considered that cells attracted one another somewhat as do sperm and ovum and relegated such attractive phenomena to the field of chemical influences.

In the present paper minute and rigorously classified descriptions are given of changes which such cells undergo when once they have come into contact.

In general two or more cells in contact glide, or crawl as it were, upon one another into some new relative position. This movement of one or both may be accompanied by a revolving or waltzing, very slowly. The form of the cells becomes changed very markedly, as is especially well shown when three cells form a row. In this case the middle one is very much compressed, as if the cells crowded together with great force.

The rearrangements and changes of shape are in some cases much as take place with soap bubbles and might be explained as the resultant of the surface tensions of the separate bubbles or cells. But in many cases the arrangements are directly opposed to the laws governing the arrangements of soap bubbles and cannot be explained on so simple a basis.

Besides the external changes in form and position there are internal changes, as is made evident by the changes in position of the pigment. In such cells as have more or less pigment this may recede from the surface to appear again in concentrated form at some one region of the cell. When several cells are together the arrangement of the pigment appears to be in some way determined with reference to the arrangement of the cells, being at like poles or in zones, etc., according to the way the cells are combined.

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[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts reviews and preliminary notes may be sent.

[2] Archiv f. Ent. d. Org., III, June 12, 1896, pps. 381–464.

The bearing of these facts upon normal development becomes evident when we recall that not only are rearrangements of cells of importance in the normal processes of cleavage in many eggs, but that they also seem to play an important part in the formation of the later embryo in the case of the eggs of Ascaris as emphasized by O. zur Strassen.[3]

Such movements of cells may then be looked for as a not unimportant factor in the production of the characteristic shapes and organs of embryos.

The explanation of the nature of these movements is by no means ready. The author recognizes that simple surface tension of a homogeneous material will not account for all the phenomena, but he is inclined to think that surface tension may be a sufficient cause provided there were a change in its character at different parts of the same cell and at different times in the same area owing to some change in the nature of the material of the cell.

A Mechanical Explanation of Cell Division.—As the phenomena of cell division form so large a part of the visible changes the embryologist studies, he will eagerly welcome any clue to their better understanding. Especially when we are offered an explanation of the complex changes of indirect or mitotic cell division, which figure so strikingly in the important early changes the egg undergoes. If weary of the idea of muscle-like contractility of fibres or the mysterious movements of chromosomes under chemical influences he will turn with relief to the mechanical views presented by Dr. Ludwig Rhumbler.[4]

The keynote of this honest attempt lies in the assumption that the observed physical changes of cell division may be due to purely *physical* causes, whatever the complexity and differences of the unknown *chemical* factors lying back of these physical changes.

The author first assumes that protoplasm is a viscous fluid, next that it has essentially the structure claimed by Bütschli, that is he regards protoplasm as a froth or foam of more liquid drops or *alveoli* surrounded by less liquid surfaces or lamellæ—in which may be fibres of soft granules arranged in rows.

In such a foam radiating lines may appear from the arrangements of the vesicles or alveoli and the author assumes that the radiations in cleaving cells are of this nature and not due to actual threads. That radiations may be formed in various preparations of soap-suds and mixture of white of egg and gelatine is shown by careful figures and by diagrams and the similarity of such artificial radiations to cell radiation demonstrated. Here a contraction of a central body, as an air-bubble, suggests the way in which the centrosome may act.

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[3] See American Naturalist, Dec. 1896, p. 1059.

[4] Archiv f. Ent. der Organismen, III, July 21, 1896, pps. 527–618.

In elucidating the phenomena of cell division on the basis of a foam structure the author takes the figures given by Ziegler for sea-urchin and nematode as a norm. In these eggs the nucleus and the attraction spheres undergo very marked changes in size while the radiations in the protoplasm outside the nucleus quickly grow long and then short. These rhythmic changes of size and distinctness lead to the following assumptions.

The centrosome absorbs liquid from the surrounding cytoplasm and then concentrates it into smaller bulk than it formerly occupied. The nucleus swells from absorbtion of liquid. The detailed application of these assumed factors to the phenomena of cell division cannot well be given in the bounds of an abstract and must be sought in the original. The author there sets forth how the absorbtion of liquid by the centrosome will lead to the formation of radiations, asters, as well as to the removal of yolk bodies, etc. from the neighborhood of the centrosome. The final division of the centrosome is brought about only in consequence of the swelling of the nucleus. This body removes liquid from the regions not affected by the centrosomes and this removal of liquid will cause a strain which may be represented as a system of curves concentric with the nucleus. Where the centrosome lies the cytoplasm is already less liquid, more viscid, while on the opposite side of the nucleus it is most liquid.

The removal of liquid from lines of alveoli causes the alveoli to become smaller and thus the rows exercise a pull upon the region of the centrosome. This pull of the alveolar material eventually parts the centrosome and draws the halves asunder. As the rows of alveoli that surround the nucleus are the longest their contraction under continued loss of liquid to the nucleus will lead to the separation of the centrosome halves till they reach the poles of the nucleus.

The observed second increase in size of the centrosomes follows this period of nuclear swelling and leads to the formation of new sets of radiations. These radii, or lines of alveoli, now reach to the cell wall and exert a pull upon it as liquid is taken in from the alveoli to the centrosomes. As the rows of alveoli become most viscid near the centrosome a more liquid region is left in the equatorial plane and here the alveolar rows finally break in the cleavage of the cytoplasm. Meanwhile the vacuole-like nucleus has been pulled apart towards the centrosomes.

After the cleavage of the cell the centrosome again ceases to absorb liquid and so passes into the resting stage. The case where there is an immediate division of the centrosome into two that remain for the subsequent cell divisions also admits of explanation upon this alveolar basis; the same is true of various other cases and phenomena.

If this attempt at an understanding of the complex marvels of cell division appears much too ineffectual it is partly due to the imperfect representation given in this abstract and in part the result of the unfinished character of the present paper which claims to be but the first of a series. In the next article the author hopes to consider the nucleus with its chromosomes and spindle; and we cannot well judge of the success or failure of the attempt till that part lies before us.

Probably few will judge that much ultimate truth has yet been discovered in the attempted explanation of such exceedingly complex phenomena but if it prove that the right line of research has been struck the author has added much to our conceptions of the forces at work in embryological processes.

PSYCHOLOGY.[1]

Experiment on Reinversion of the Retinal Image.—The inversion of the image on the retina, and its influence upon our visual perception of space, have given rise to considerable discussion in the past. That we see things in an upright position notwithstanding this inversion, has seemed to many writers to require special explanation. Accordingly, some have assumed a reinversion of the image in the cerebral cortex, while others have adopted a theory of visual projection which makes the retinal inversion essential to upright vision. During all this discussion the possible relativity of *up* and *down* escaped notice for a long time. What we mean by down is simply the *ground side*, and by up simply the *sky side.* As everything imaged on the retina is inverted, there is no point of reference to give an indication of the inversion of the rest. The only problem that arises, then, is concerning the co-ordination of visual with tactile space. This is a real difficulty: I see my left hand *down* at my *left* side; I feel it in the same place. How can this co-ordination be reconciled with the fact of retinal inversion? There have been attempts to explain the situation in two different ways; either on one of the theories mentioned above, which assume the subjective space-scheme to be something absolute and rigid, and which postulate a cortical or projective re-inversion of the visual figure to conform with the uninverted tactile figure; or else by supposing the space-scheme plastic, so that it is capable of being determined, or at least "oriented," by experience. According to the latter view the visual and tactile "spaces" are not necessarily the same in origin; they have come to coincide only through habitual association.

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[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.

Dr. G. M. Stratton, of the University of California, reported at the recent Psychological Congress at Munich an experiment of his own, which was, so far as it went, a crucial test between these two lines of theory. The details have since been published in the *Psychological Review*, (Vol. III, pp. 611–617), from which I quote. By means of a pair of convex lenses, he succeeded in inverting the field of vision without otherwise altering its relations. The effect of this contrivance, when placed to the eye, was to give a re-inverted (or upright) retinal image. For the experiment, the apparatus was bound to the face in such a way as to exclude from the right eye all light except that passing through both lenses, and the visual field of the other eye was darkened. The observer wore the apparatus constantly for two days, except at night, when his eyes were carefully bandaged; so that during all this time he saw only the inverted field of vision.

"The course of experience," says the author, in reporting the results, "was something as follows: All images at first appeared to be inverted; the room and all in it seemed upside down. The hands when stretched out from below into the visual field seemed to enter from above. Yet although all these images were clear and definite, they did not at first seem to be real things, like the things we see in normal vision, but they seemed to be misplaced, false, or illusory *images* between the observer and the objects or things themselves. For the memory-images brought over from normal vision still continued to be the standard and criterion of reality. The present perceptions were for some time translated involuntarily into the language of normal vision; the present visual perceptions were used simply as signs to determine how and where the object would appear if it could be seen with restored normal vision. Things were thus *seen* in one way and *thought of* in a far different way. This held true also of my body. * * *

"As I moved about in the room, the movement of the visual images of my hands or feet were at first not used, as in normal vision, to decide what tactual sensations were to be expected. Knocks against things in plain sight were more or less of a surprise. I felt my hand to be in a different position from that in which I saw it, and could not, except by cool deliberation, use its visual image as a sign of impending tactual experience. After a time, however, repeated experience made this use of the visual image much less strange; it began to be the common guide and means of anticipation. I watched my feet in walking, and saw what they were approaching, and expected visual and tactual contact to be reported perceptionally together. In this way the limbs began actually to feel in the place where the new visual perception reported them to be. The vivid connection of tactual and visual perceptions began to take away the overpowering force of the localization lasting over from normal vision. The seen images thus became *real things* just as in normal sight. I could at length *feel* my feet strike against the *seen* floor, although the floor was seen on the opposite side of the field of vision from that to which at the beginning of the experiment I had referred these tactual sensations. I could likewise at times feel that my arms lay between my head and this new position of the feet; shoulders and head, however, which under the circumstances could never be directly seen, kept the old localization they had had in normal vision, in spite of the logical difficulty that the shape of the body and the localization of hands and feet just mentioned made such a localization of the shoulders absurd.

"Objects lying at the moment outside the visual field (things at the side of the observer, for example) were at first mentally represented as they would have appeared in normal vision. * * * But later I found myself bringing the representation of unseen objects into harmonious relation with the present perception. They began now to be represented nos as they would appear if normal vision were restored, but as they would appear if the present field of vision were widened or moved so as to include them. * * *

"As to the relation of the visual field to the observer, the feeling that the field was upside down remained in general throughout the experiment. At times, however, there were peculiar variations in this feeling according to the mental attitude of the observer toward the present scene. If the attention was directed mainly inward, and things were viewed only in indirect attention, they seemed clearly to be inverted. But when, on the other hand, full attention was given to the outer objects, these frequently seemed to be in normal position, and whatever there was of abnormality seemed to lie in myself, as if head and shoulders were inverted and I were viewing objects from that position, as boys sometimes do from between their legs. At other times the inversion seemed confined to the face or eyes alone.

"On removing the glasses on the third day, there was no peculiar experience. Normal vision was restored instantaneously and without any disturbance in the natural appearance or position of objects."

As the author remarks, the experiment did not cover enough time to determine the full power of experience. But the main point at issue—the two opposing views of subjective space already alluded to—seems to have been fairly well settled. There was shown to be a possibility of co-ordinating our tactile space with an artificially inverted visual space; the localization of the hand (*e. g.*) by *feeling* was gradually assimilated to its position in the new visual field, etc. There was not, of course, time to overcome completely the experience of ages in one direction. But that it was overcome at all, and that the new experience was to a large degree reconcilable with the tactile data, shows clearly, I think, that the original co-ordination is quite independent of any mental projection or cerebral re-inversion. The two space-schemes arise separatively; that they correspond, point for point, as they do, is owing simply to repeated and uncontradicted experience.

It is to be hoped that the author will be able to repeat the experiment again and observe the effect of a longer continuation of the experience. He might be able eventually to get rid of the persistent inversion of the head and shoulders, perhaps, by looking at himself frequently in a mirror. If a single pair of lenses could be devised to cover both eyes, the difficulties arising from imperfect convergence might be overcome, and the experiment extended to binocular vision.

HOWARD C. WARREN.

Birds' nests and instinct.—Some very interesting observations on the nesting habits of birds recorded by Dr. R. Williams in the October (1896) number of the Zoologist are worthy of note, the more so since they bear upon the subject of instinct and the power of learning from experience that has lately been occupying the attention of certain psychologists. It must be regretted that Dr. Williams' observations seem to be hap-hazard and, therefore, lacking the detail that would make them conclusive. In this respect he is not different from the host of oological observers that claim the title of scientists. Take for instance his note regarding cuckoos hunting their nests. He says "my son informed me one day that he knew where a cuckoo was going to lay. He said he had seen a cuckoo fly out of a hedge, which on examination he found to contain a hedge-sparrow's nest ready for eggs. The boy's expectation was realized. He visited the nest repeatedly, and one day announced that the Hedge-sparrow had begun to lay. Three days later he brought me the contents of the nest, consisting of one cockoo's egg and the clutch of hedge-sparrow's eggs." Now, it may be asked, how, from this account, is one to be sure that the egg was laid by the cuckoo that was seen to fly out of the hedge? There is no statement that the bird was watched from day to day, or that it was known to roost and feed in that immediate vicinity. No one is said to have gone early in the morning to the roosting tree and from that time follow and note the actions of the bird through the day until it went to roost again for the night. It is improbable that such observations were made in this case in this way. Yet it is not impossible to make them thus carefully, for it has been done in studying the feeding habits of our American cuckoo.

Aside from this criticism the observations are very interesting so far as they go. For instance in 1889, he found the nest of a European blackbird situated in a depression in the ground very much as one usually finds the nests of the skylark. Several other blackbirds nests were found by the keeper of the wood, which were similarly placed. Two thrushes nests were also found in the neighborhood, and like those of the blackbirds on the ground. The wood abounded in thickets and fir trees, but these more favorable places contained very few blackbirds or thrushes' nests. It was learned upon inquiry that the proprietor finding the wood a stronghold for these species had made systematic raids upon their nests in consequence of their destruction of his fruit. Did the birds profit by experience and seek a safer position for their nests?

The other instance to be noted concerns the sandpiper. "In May, 1886, just when these birds were commencing to set," the author says, we had a very heavy rainfall, heavier than any remembered by my father, who is over eighty years of age. The land on each side of the river near my house was under water. The common sandpiper usually nests on patches of gravel thrown up by the water, and more or less covered with docks and other weeds. These places being flooded, the nests were swept away and destroyed. On the subsidence of the flood, the sandpipers built again on their old sites, only to find their nests swept away by another flood. In the nesting season of the following year (1887), wishing to secure a few clutches of sandpiper's eggs, I searched in the usual places for a whole morning without success. The next day I accidently came upon a sandpiper's nest containing four eggs, the nest being placed at the foot of a willow fully 100 yards from the river. The discovery put me on the right track, and I found six more nests in various positions, all a long way from the river." Evidently this was profiting by experience and the conclusion is borne out by the fact that the birds seemed to conclude that the new position was not so favorable as the old to which next year they returned.

His numerous other observations are interesting but space permits noting only the case of a wood warbler—which usually makes a covered nest—making a nest in a situation such that the top was formed by the root of a tree.—F. C. KENYON.

Psychic Evolution.—In the paper by Mr. Nichols which is concluded in this number of the NATURALIST, is to be found the Neodarwinian doctrine of psychic evolution, which is also adopted by Prof. W. H. James. I have already criticised this doctrine as expressed by Prof. Mark Baldwin in a paper in the NATURALIST (1895, April, p. 342; May, pp. 422–28). This doctrine is in short, that structures come into existence before the functions which they represent, and it is, therefore in direct opposition to the Lamarckian view, that structures are the result of functions. Of course the Lamarckian view does not deny that completed structures perform their functions better than they can be performed by unspecialized structures. This doctrine has the distinct advantage as a hypothesis, of really doing what a doctrine of evolution is supposed to do, i. e. of explaining the origin of structures. This the Neodarwinian doctrine does not do. As a theory of origin of organs of specific consciousness and of their functions, it is quite the same whether we assume with Prof. James that central organs must first exist, or whether we believe with Prof. Wundt that special end-organs must first exist. The fact is that a doctrine that assumes that any organs must be primary and not secondary is in so far not a doctrine of evolution.

The evolutionary doctrine of the origin of organs of special consciousness must be the same as that which explains the origin of other organs. That is, that energies acting as stimuli, external and internal, impinging on live protoplasm, produce modifications of its structure. If these structures are concerned directly or indirectly in the production or modification of states of consciousness, their use, or the subjection of the tissues to the stimuli which produce them, will produce pleasure or pain. The organism proceeds to repeat or avoid the exposure thereafter accordingly, and use and disuse have their beginning.

Whether any form of general and diffuse consciousness preceded in time special forms of consciousness, or whether all forms of consciousness have been due to corresponding stimuli, is a subject of present research. It can be assumed with much probability however, that the stimuli of pressure, heat, light, and hunger, would produce different forms of consciousness, since they would produce different effects on the ultimate structure.

That this is the proper order of psychic evolution may be inferred from two considerations. (1) The sensations due to pressure, light, heat, hunger, etc. are experienced by animals of low as well as of high organization. (2) The order of structural evolution is from the homogeneous to the heterogeneous, or from the generalized to the specialized.—E. D. COPE.

MICROSCOPY.

Formal,[1] (Formaldehyde 40 per cent. solution).—Practical experience with Formal in the Laboratory. By Bert B. Stroud, D. Sc., Instructor in Physiology, Vertebrate Zoology, and Neurology. Cornell University, Ithaca, N. Y.

During the past two years much interets has been shown concerning formaldehyde, as an agent for hardening and preserving anatomic material. An extensive literature has arisen, which as Lee[2] has observed, is sadly confused by the indiscriminate and incorrect use of the terms *Formol* and *Formalose.* The term *formol* is a very bad one. Because according to the principles of chemical terminology the suffix *ol* is applied to a different class of compounds, examples of which are alcohol, glycerol, and phenol.

The molecular structure of the aldehydes differs from that of the examples given.

Formalose might be confused with *formose,* a mixture of carbohydrates made from formaldehyde. *Formalin* is a term which has no meaning.

We have to deal with a definite chemical individual; why then should it not be called by its own proper name or by a suitable contraction of that name? It may be urged since the commercial product is a solution of gaseous formaldehyde in water, that the name should indicate such solution. But the term *hydrochloric acid* is an excellent precedent for saying formal or formaldehyde, since the acid of the laboratory is a solution of the gas HCl in water. But every one calls the solution hydrochloric acid.

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[1] The term *Formaldehyde* is a cumbersome one. Professor W. R. Orndorff has suggested that *Formal,* from *Formal-dehyde* is the best scientific contraction. The term *Methanal,* for formaldehyde, was adopted by the Geneva Congress of Chemists.

[2] Formol or Formaldehyde? *Anatomischer Anzeiger. XI, No. 8, October 24, 1895, S. 255–256.*

The strength of the 40 per cent. solution of formal is subject to some variation, since on standing for a long time it deposits a precipitate of metaformal and the solution is weakened by the amount of formal precipitated. Metaformal may also be obtained, as a bluish-white amorphous powder on simple evaporation of the commercial 40 per cent. solution. This amorphous form is readily soluble in water heated to 60°-70° C. It can be easily manufactured and would soon become a commercial article if there were a demand for it. The writer suggests that this would be the most convenient and economical way to use formal. Solutions of definite strength could be easily prepared, by simply weighing the proper amount and dissolving it in water heated to 70° C. Considerable expense for packing and transportation would be avoided.

Action of formal on animal substances.—The writer is inclined to believe that the action of formal varies with the kind of tissue, its source, whether from an aquatic or a terrestrial vertebrate, and the period of immersion in the liquid.

1. *Action on white of egg.*—Six portions of 4 cc. each were treated with solutions of formal of the following strengths,—0 2 per cent.; 0.8 per cent.; 1.6 per cent.; 3.2 per cent.; 8 per cent.; 40 per cent. The mixtures were put into vials and tightly corked. A flocculent precipitate resulted. It was slight in the dilute solutions, but more copious in the bottle which contained the 40 per cent. formal. After 48 hours, the dilute solutions had assumed a translucent appearance but remained perfectly fluid. The 40 per cent. solution was of a jelly-like consistency and was more opaque than the weaker solutions.

2. The mucus of petromyzon, fishes, and necturi was coagulated; at first translucent, it finally became more or less opaque and sometimes could be peeled off from the skin.

The first general effect of formal on animal tissue is to coagulate the proteids; this fact probably accounts for its value in the Golgi method. Fats are apparently little altered. It has been used in this laboratory for the preservation of lampreys, Amia, and other fish-like vertebrates, of amphibia, reptiles, birds, mammals and of brains. The action on vertebrates up to and including amphibia has been more or less satisfactory. But the results upon muscles and viscera of reptiles, birds, and mammals where the specimens were immersed for four months or longer were far from being satisfactory. The action is rapid at first, then proceeds more slowly, several months being required to obtain the final effect. However, material for *immediate dissection*[4] may be kept in 2 per cent. formal (formal 2 cc., water 98 cc.).

[4] Material will keep quite well for four to six weeks.

Among the undesirable effects may be mentioned:

1. Swelling of tissue from absorption of water.

2. Partial solution of connective tissue elements.

3. Diminished elasticity, sometimes brittleness, of glands, ducts, and membranous viscera so that they may not survive the rough usage of the average beginner.

4. The action on tissues rich in proteids as muscles of the terrestrial vertebrates is something like dissociation. The connective tissue is either softened or dissolved so that the fasciculi and fibres are easily teased apart.

5. Muscles are shortened so that the limbs are usually flexed. If the limb is forcibly extended, either the muscles themselves or the tendons break. The dissection of individual muscles is liable to tear them. If the specimen has been in the fluid for several months, the muscles become rigid and brittle. If the limb be forcibly adducted, the humerus or femur will usually break. The separation of individual muscles and the demonstration of their actions are very difficult or even impossible.

In June, 1895, a lot of sea-lampreys were prepared by injecting 2 per cent. formal through the dorsal aorta. They were then put into 2 per cent. formal. The solution was changed three times and about Sept. 1, they were put into 50 per cent. alcohol. In Jan., 1896, the specimens had shrunken slightly. Preservation was fair, with the exception of a long longitudinal check in the axon (notochord) and the blood vessels did not show so well as in the previous year when alcohol was used for injection and preservation.

Brains.—Formal appears to be almost an ideal fixer and preservative for brains where gross morphology is the object. They are tough and flexible; the alba, cinerea, and fibre tracts are well differentiated. The natural color is more perfectly retained than where other agents are employed. But membranous portions, telas, and plexuses are not so well preserved as where alcohol is used.

The following mixture was satisfactorily employed for sheep brains—a 2 per cent. solution of formal:

Formal (40 per cent. solution) . .	20 cc.
Sodium chloride	46 grams.
Water	1000 cc.

After 5–8 days the specimens may go into 2.5 per cent. formal indefinitely.

Eyes.—Sheeps' eyes were well preserved in 2 per cent. formal; the cornea, lens, and vitreum had a more natural appearance but the lens, capsule, and recti muscles were much better preserved when alcohol was used.

The chief objections to formal are:

1. It does not preserve well the plexuses and membranous parietes of the brain.

2. It is in unstable chemical equilibrium.

3. The conditions attending its use are favorable to chemical change, *i. e.*, (a) solution, (b) moderate heat, (c) the presence of substances themselves in unstable chemical equilibrium.

4. The large excess of water present causes tissue to swell and aids in dissolving connective tissue.

5. The cost of a given solution is less than that of alcohol, but the renewal of solutions brings the total expense up to nearly that of alcohol free of tax; and in the writer's judgment, excepting for brains and perhaps for aquatic vertebrates, the final result is less satisfactory.

SUMMARY.

1. The most suitable contraction of the name *Formaldehyde* is *Formal. Formalin* is meaningless. *Formol* is incorrect. *Formalose* is misleading.

2. Some uniform standard for preparing solutions is desirable.

3. Formal is an unstable chemical compound. It polymerizes on standing. A precipitate of Para- and Metaformaldehyde, insoluble in water at ordinary temperatures, is formed and the solution is weakened by the amount of the precipitate.

4. Para- or Metaformal may be procured in the dry form and solutions can be prepared when desired by simply dissolving the required amount in hot water (70° C.). This would be the more economical way to nse formal.

5. Formal coagulates proteids and dissolves connective tissue. The action proceeds slowly and the final effect is reached in about four months.

6. Solutions of formal will freeze so that it is unsafe for the storage of museum preparations.

7. Formal, as a general preservative for terrestrial vertebrates, is unsatisfactory.

Formal appears to give good results for:

a. The fixation and preservation of brains for the study of gross morphology and fissures.

b. For the preservation of the cornea and vitreum of the eye.

c. For the Golgi method of staining nerve cells.

d. For Weigert's method.

e. For the temporary preservation of anatomic material.

f. Perhaps for the preservation of aquatic vertebrates.

g. For hardening material in which the blood vessels have been injected with colored gelatin.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—December 2d.—The following communications were made: "The Early Services of Mr. Thomas T. Bouvé to the Society," by Charles J. Sprague and James C. White; "Mr. Bouvé's Work in the Society Since 1870," by Alpheus Hyatt; "Mr. Bouvé's Work in Geology and Mineralogy," by W. O. Crosby.

December 16th.—The following papers were read: Prof. F. W. Putnam, "Statement Concerning Some Recent Discoveries at Trenton, N. J., Bearing Upon the Early Presence of Man in the Delaware Valley;" Prof. G. Frederick Wright, "The Extent of Preglacial Erosion in the United States, and its Bearing on the Question of the Length and Date of the Glacial Period."—SAMUEL HENSHAW, *Secretary.*

American Philosophical Society.—December 18th.—Drs. W. H. Furness, 3d, and H. M. Hiller made a preliminary report on their explorations in Borneo and the Loochoo Islands.

University of Pennsylvania Biological Club.—December 7th. Program.—"Demonstrations of Some Mexican Plants," Dr. John W. Harshberger; "Demonstrations of Slides Showing Conjugation of Nuclei in the Intestinal Cells of Land Isopods," Dr. E. G. Conklin. Reviews: Botanical, Dr. J. M. Macfarlane, Dr. H. C. Porter; Chemical, Dr. Mary E. Pennington; Psychological, Dr. Lightner Witmer. Original Communications: "Diseased Action and Senility, Considered in Connection with Biological Work," Dr. J. H. Allen.

December 21st Program.—Demonstrations: Slides showing deformation of nuclei in the intestinal cells of Land Isopods, Dr. E. G. Conklin. Reviews: Botanical, Drs. Macfarlane, Harshberger, Porter; Chemical, Dr. Mary E. Pennington; Psychological, Dr. Lightner Witmer; Pathological, Dr. Ferree Witmer. Original Communications: "The Native Dahlias of Mexico," Dr. John W. Harshburger.—H. C. PORTER, *Secretary.*

SCIENTIFIC NEWS.

Mr. Gosselin, of the British Embassy in Berlin, mentions in a recent report (says the *Times*) that the question of preserving big game in German East Africa has been under the consideration of the local authorities for some time past, and a regulation has been notified at Dar-es-Salaam, which it is hoped will do something toward checking the wanton destruction of elephants and other indigenous animals. Under this regulation every hunter must take out an annual license, for which the fee varies from five to 500 rupees, the former being the ordinary fee for natives, the latter for elephant and rhinoceros hunting, and for the members of sporting expeditions into the interior. Licenses are not needed for the purpose of obtaining food, nor for shooting game damaging cultivated land, nor for shooting apes, beasts of prey, wild boars, reptiles, and all birds, except ostriches and cranes. Whatever the circumstances the shooting is prohibited of all young game—calves, foals, young elephants, either tuskless or having tusks under three kilos, all female game, if recognizable—except, of course, those in the above category of unprotected animals. Further, in the Moschi district of Kilima-Njaro, no one, whether possessing a license or not, is allowed without the special permission of the Governor to shoot antelopes, giraffes, buffaloes, ostriches and cranes. Further, special permission must be obtained to hunt these with nets, by kindling fires, or by big drives. Those who are not natives have also to pay 100 rupees for the first elephant killed, and 250 for each additional one; and 50 rupees for the first rhinoceros, and 150 for each succeeding one. Special game preserves are also to be established; and Major von Wissmann, in a circular to the local officers, explains that no shooting whatever will be allowed in these without special permission from the Government. The reserves will be of interest to science as a means of preserving from extirpation the rarer species, and the Governor calls for suggestions as to the best places for them. They are to extend in each direction at least ten hours' journey on foot. He further asks for suggestions as to hippopotamus preserves, where injury would not be done to plantations. Two districts are already notified as game sanctuaries. Major von Wissmann further suggests that the station authorities should endeavor to domesticate zebras (especially when crossed with muscat and other asses and horses), ostriches, and hyena dogs crossed with European breeds. Mr. Gosselin remarks that the best means of preventing the extermination of elephants would be to fix by international agreement amongst all the powers on the East African coast a close time for elephant, and to render illegal the exportation or sale of tusks under a certain age. (Nature, Oct., 1896.)

Dr. Baumann, who died at Freiburg, on November 2d, in his forty-ninth year, was Professor of Medical Chemistry at the University of Freiburg i. B. The son of a chemist he served the full term of a pharmaceutical apprenticeship and then entered the Technical College of Stuttgart in order to complete his studies in physics, chemistry and natural science. Thence he went to Tübingen to take his diploma. There the noted physiologist, Hoppe-Seyler, recognized his talent and made him his assistant; and when he left Tübingen to take a professorship at the University of Strassburg, in Alsace, in 1872, Baumann accompanied him. In 1879 Baumann was made Director of the Chemical Department of the Physiological Institute of Berlin. In 1882 he went to Freiburg as ordinary professor of medical chemistry, and there remained until his death.

Dr. Theodor Morgo died September 5, 1896, at Szent Lörincz in the Comitat Boranyu. He was born in 1816, and at the time of his death was Professor of Zoology at the University of Budapest.

Dr. Raffaele Zoja died September 26, 1896, in consequence of an Alpine catastrophe. Dr. Zoja was born March 10, 1869 and at the time of his death had done considerable work in the field of histology and embryology. Under Maggi he worked upon Hydra; at the Naples Zoological Station, upon the cell structure of the lower invertebrates; at Messina with Kleinenberg, on the ontogenomechanics of Medusa; and in Berlin with O. Hertwig on the development of *Ascaris megalocephala.* This last work he had just finished at the time of his death.

Dr. August Louis Boot died Aug. 30, 1896. He was born Sept. 18, 1821 and took the degree of M. D. in 1845. Medicine not proving to his taste he gave up practice for the study of conchology in which he became well known as the author of "Materiaux pour servir a l'étude de la famille des Mèlaries" (1868), "Catalogue scientifique des especes qui composent la famille des Mèlaniens" (1862), and "Die Melaniaceen in Abbildungen nach der Natur mit Beschreibungen."

It is to be noted that the salary attached to the position of Mackay Bacteriologist to the Linnæan Society of New South Wales, which recently advertised in *Nature* for applicants, arises from £12,000 bequeathed by Mr. Wm. Mackay. His total benefactions to the society amount to £100,000. The object of the appointment is entirely the advancement of natural knowledge by research.

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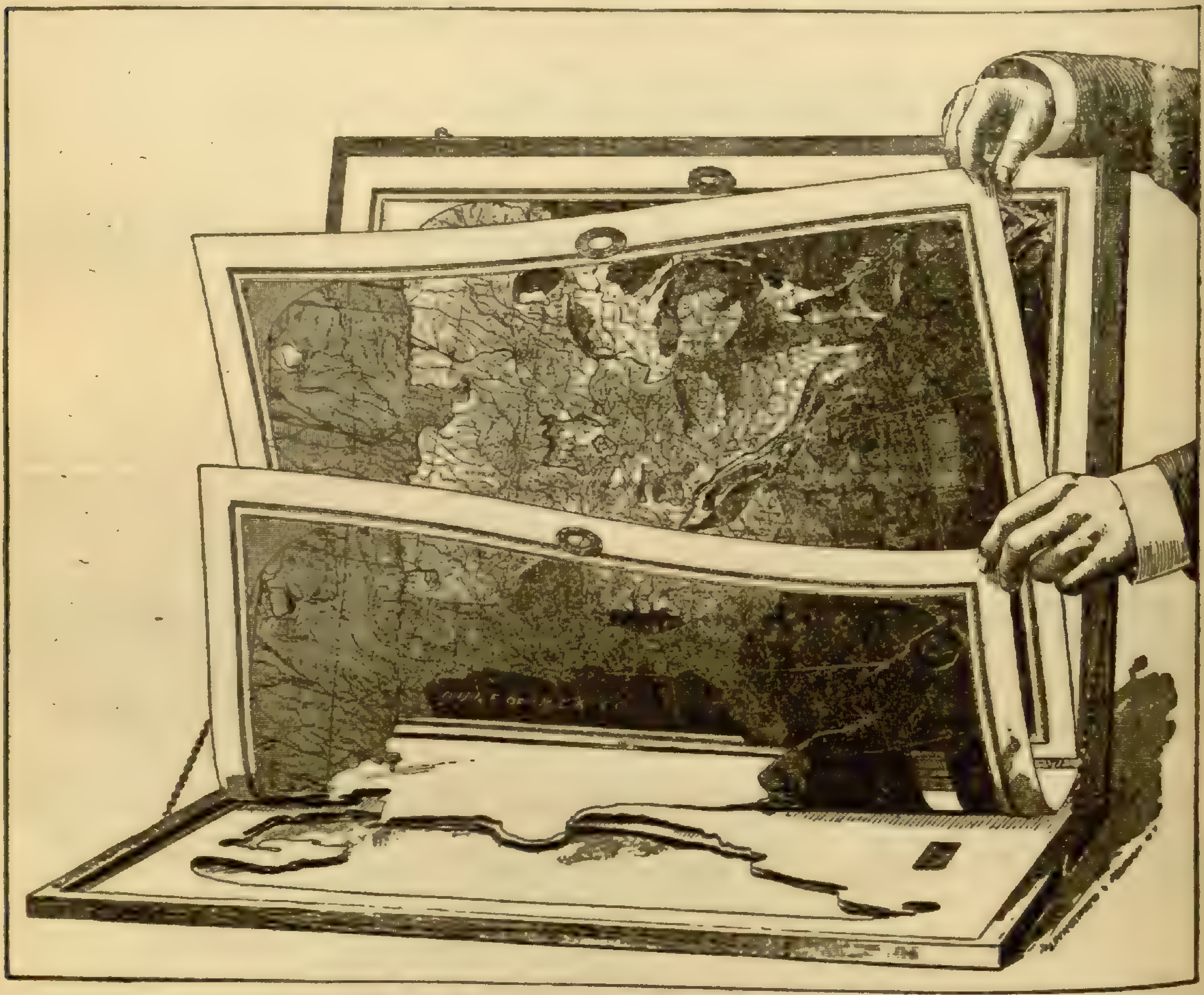

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THE

AMERICAN NATURALIST

VOL. XXXI. February, 1897. 362

NOCTURNAL PROTECTIVE COLORATION OF MAMMALS, BIRDS, FISHES, INSECTS, ETC.

BY A. E. VERRILL.[1]

Although much has been written regarding the protective and imitative colors and forms of various animals, as seen by daylight, very little attention has been paid to their protective colors as seen by moonlight, twilight, and starlight, when large numbers of species of small mammals and fishes, and numerous insects are most active in search of food and most of the large carnivorous and insectivorous species are abroad in search of their prey. Moreover most birds and many fishes and insects sleep in exposed situations and are thus subject to the attacks of nocturnal predaceous species. The latter, in turn, need protective colors for the night-time, in order to avoid the notice of their prey. One of the most evident effects of moonlight or starlight is to give very black shadows. In the case of bright moonlight these black shadows of trees, etc., may be broken up by patches of white moonlight. Therefore, black or dark-brown animals are nearly invisible in such shadows. If black animals have patches of white or light yellow these will serve a useful purpose by breaking up and obscuring the outlines of bird or beast and look like patches of moonlight on a shadow.

---

[1] (Abstract of a paper read before the Morphological Society. Dec. 30, 1896.)

Accordingly we find many nocturnal carnivorous mammals that are black (*e. g.*, minks, fisher, bears) and some that are black and white. We also find numerous black, as well as black and white, birds, insects, etc., whose colors can best be explained as due to the influence of natural selection among protective nocturnal colors. The dark gray and brownish-gray colors so common among small nocturnal mammals, like mice, arvicolæ, moles, shrews, marsupials, etc., are highly protective at night. Even when these creatures are running about among green grass and weeds they are scarcely visible in a feeble light. Such colors are not at all protective in the day time, in such places. Moreover, such mammals usually hide in holes or crevices in the day time, where the color does not matter.

Most nocturnal black, brown, and dark gray insects, like the ground beetles, crickets, ants, etc., unquestionably find protection in these colors, though they are conspicuous in the day time. Among diurnal birds and insects there are, also, many cases of conspicuous and bright colors that become protective by moonlight and starlight, when these creatures are asleep or quietly resting among foliage or flowers, and most exposed to their nocturnal enemies. In general, it may be said that in all cases where black or very dark colors are strongly contrasted with white, yellow, or other light markings, these patterns are more likely to be protective at night than in the day time. Such colors may be due, in many cases, to other causes, but when no special cause for their origin can be found, they are probably due, in most cases, to nocturnal protective value, and this can be definitely ascertained by a study of the nocturnal habits and surroundings.

Many of our native butterflies have bright and conspicuous colors which are the reverse of protective in the daytime, when their acute senses and active habits afford fair protection. But I have observed that at night, when roosting on flowers, their colors so blend with those of the flowers as to render them inconspicuous, even in good moonlight. Many species of *Argynnis* and allied genera are conspicuously marked with red, brown, and orange on the under side of the wings, and have bright silvery spots or blotches in addition, so that they are conspicuous in the daytime. I have noticed that when these large butterflies are roosting at night on goldenrods and other favorite flowers, with their wings folded up over the back, their colors not only blend with those of the flowers but their silvery spots shine in the moonlight like the dewdrops that surround them.

Many birds, insects, etc., have acquired colors that are equally protective both by day and by night. This is true in the case of the green colors of those that live on or amongst foliage, and in the case of those that have dull gray and brown colors, imitative of the bark of trees on which they rest. It also applies to bright colored insects that live on flowers of the same colors. But the multitudes of cases, which cannot be explained in this way, are probably due to special nocturnal protection.

Many fishes that rest at night amongst the stems of aquatic grasses, sea-weeds, etc., have dark or black stripes crossing the body transversely, obliquely, or longitudinally. Such colors are highly protective at night, when they are most exposed to their predaceous enemies, for the dark bands then resemble the dark stems and shadows of the weeds, and serve admirably to conceal the outline of the fish. Black fins and tails serve a similar purpose. Such markings of fishes are generally more distinctly developed at night than in the day time, as explained in the next article.

In a similar way, the striped colors of the tiger are doubtless more effective for concealment at night, or in the dusk of evening, among the stalks of reeds and shrubs, than in the day time. The same is true of the colors of the spotted jaguar, leopard, etc.

The common raccoon is fairly well protected even in the day time by its gray fur, when resting on the large gray branches of trees, but as it generally hides by day in holes, we must regard its peculiar coloration as due to nocturnal protection, for which it is emniently adapted.

Nocturnal and Diurnal changes in the Colors of Certain Fishes, and of the Squid (Loligo), with notes on their Sleeping Habits.—These observations were mostly made in the U. S. Fish Commission Laboratory, at Wood's Holl, Mass., in 1885 to 1887, when the laboratory was in excellent condition for biological studies. In order to observe the nocturnal habits of the fishes, etc., in the aquaria, the gas was turned down low, so as to give a light just sufficient for distinct vision, after every one except myself had retired. Great care was also taken not to jar the floor or furniture. Under these conditions many interesting observations were made. It was noticed that while many species became very active others took this opportunity to sleep, and in doing so, assumed unusual colors and positions. Several species of fishes, while asleep, had colors very different from those seen in the day time. Others showed a decided increase in the intensity or contrast of their colors, without changing the pattern. The latter was the more common habit, and was noticed especially in the case of species that have longitudinal, transverse, or oblique dark bands or stripes or irregular mottlings. As previously explained, these dark stripes are highly protective colors for fishes that rest at night among weeds and grasses. Among those showing this change are several species of minnows (*Fundulus*), and the king-fish (*Menticirrus nebulosus*), in which the blackish stripes come out more strongly and clearly when asleep than when awake. The black sea-bass, (*Serranus furvus*), especially when young, shows its black markings more clearly when asleep. The sea robins (*Prionotus palmipes* and *P. evolans*), and various species of flounders show more strongly contrasted and darker colors than in the day time. But the scup or porgy (*Stenotomus chrysops*) shows much more remarkable changes in color. This fish, in the day time, usually has a bright silvery color, with a brilliant pearly iridescence, but at night, while asleep, it becomes dull bronzy or gray, and is crossed by about six transverse black bands, colors very effective for concealment among the stalks of eel-grass or sea-weeds. If aroused by suddenly turning up the gas, it immediately resumes its day time colors. If killed in alcohol this fish, and many others, as well as the squids, usually taken on their nocturnal colors, though these generally soon fade out.

A species of file-fish (*Monacanthus*) which has, in the day time, mottled olive-green and brown colors, with slightly darker fins and tail, when sleeping becomes pallid gray, or nearly white, and the fins and tail become black. This and other related species took curious positions while asleep, often leaning up obliquely, with the back against the glass of the aquaria and the abdomen resting on the bottom ; sometimes, also, leaning up in a corner of the aquarium with the body curved, or against stones in similar attitudes.

The tautog or black fish (*Tautoga onitis*) usually sleeps on one side, resting under the edges of rocks, or half buried in sand or gravel, much after the manner of flounders. They often had their bodies variously bent. This fish did not show any marked change of colors, but its ordinary dark colors are nocturnally protective.

The common squid, when resting quietly on the bottom, late at night, and apparently asleep, takes on its darkest colors, due to the full expansion of the brown and purple chromatophores, so that the color is much like that developed when excited in the day time, and similar to the usual color of alcoholic specimens. When swimming quietly in the day time the usual color is pallid or translucent bluish-white, with very small, scattered, dark specks, due to the strongly contracted chromatophores. It takes this color, also, when resting upon the light sandy bottoms, waiting for the approach of the small fishes on which it feeds. It has the power of changing its colors at will, but its nocturnal color is probably automatic and protective.

THE INFERIOR BOUNDARY OF THE QUATERNARY ERA.

By Oscar H. Hershey.

The great diversity of physical conditions of the earth's surface in the Quaternary era of its geological history, has been conducive to much legitimate difference of opinion among students as to the most natural boundaries of the era. A few consider it proper to commence it at the opening of deposition of the now well known Lafayette formation. A few others, the writer included, would date it from the close of the Lafayette epoch of aggradation in the coastal plain and Mississippi embayment regions. But the larger number of geologists are accustomed to refer its beginning only as far back as the first marked extension of land ice in North America and Europe, namely, to the opening of the Kansan epoch. It is the purpose of this paper to defend, if possible, the intermediate proposition.

The Quaternary era, as limited by many geologists, was characterized by a great extension of land ice in the form of broad *névés* passing into and bordered by vast glaciers. As known from their effects, these masses of glacial ice were of great extent, covering at their maximum expansion millions of square miles of the northern temperate zone, and having great development on other parts of the earth's surface, notably in the southern portion of South America, and on nearly all high mountain ranges even under the equator. But between the several maxima of cold, producing and in part produced by these glaciers, there seem to have been climatic periods of comparative mildness. These are commonly known as interglacial epochs because the deposits which belong to them are frequently found interbedded with those which are due to direct ice action, and also because they separated the several epochs whose most characteristic condition was glaciation. But the interglacial epochs were longer than the alternate glacial epochs, so that in point of time, the Quaternary era, even considered as synonymous with the term, "The Ice Age," did not have glaciation as its predominating condition. In the light of modern discoveries in the later geologic history of Europe and America, the "Glacial period" becomes more figurative than real. Glaciation was the most remarkable and the most prominent feature of the Quaternary era, but its importance was not so great as to overshadow the claims of other natural conditions to the right of constituting the essential elements in the definition and limitation of the era.

It is the opinion of the present writer that the era whose early boundary is under discussion, was naturally set apart from all preceding time by a difference in climate, and to a less marked extent by a difference in fauna and flora; not so much by new species of animals and plants as by a different distribution of them. Just as the present climate differs from that of the Tertiaries so also differed the general Quaternary climate therefrom. We are, in fact, probably living under the normal conditions of the Quaternary era; at least there is no very important difference between the interglacial floral and faunal remains and those of the present time. But all of the various lines of research into the conditions prevalent in the Tertiary era, combine to demonstrate that its climate, in any given geographic district, was somewhat milder than in the same locality at the present time. It is the time of change from the mild Tertiary climate to the somewhat colder Quaternary climate that I would consider as the most natural and, therefore, the most convenient divisional line between the two eras.

In endeavoring to fix this time of climatic transition by means of the effects produced, we are confronted by the imperfection of the geological record. A large part of the interval between the time of pronounced Tertiary mildness and early Quaternary severity, was occupied by conditions not favoring the preservation of organic remains, namely, by an elevated condition of the land and rapid erosion. Hence, we are reduced to the necessity of theoretically deducing the most probable cause of such a general change in climate, and then endeavoring to fix by evidence, if possible, the time when said cause or causes came into operation.

The general climate of any portion of the earth's surface is determined by latitude, i. e., by the amount of heat received from the sun. But there are other influences which combine to modify the climate of any given locality. The most important are the extent and position of the bodies of land, the heighth and trend of mountain ranges, and the relation between ocean and air currents. If all these conditions remain unchanged for a very long period, no great diversity of climate will effect the locality. But any disturbing influence, destroying the relations between the conditions mentioned must, *in rerum naturæ*, effect the climate of the entire earth to a certain extent. Of strictly terrestrial causes there are none so potent to bring about this result as great earth movements, changing the relation between the continents and seas, thus modifying the ocean currents, and by presenting barriers in the form of high mountain ranges, interfering with the courses of the prevailing winds. In view of the fact that astronomical causes of the changes of geologic climates are not capable of practical demonstration, while the terrestrial or land movement theory not only is capable of such proof, but already such evidence has been collected to indicate at least a time relation between the main land disturbances and the most important climatic changes, I shall consider only the latter hypothesis in the present discussion.

If the peninsula of Florida were uplifted several thousand feet into a high narrow plateau, and then dissevered by the erosion of deep valleys into separate mountain peaks and ridges, the present warm temperate and subtropical flora and fauna would largely disappear. With the production of a rocky sea-cliff about its borders and the destruction of the swamps and marshes, the palmetto and alligator, each the most characteristic portion of the Floridian flora and fauna, would be eliminated; forced to migrate or become extinct. With them would go the destruction of many other animals and plants. The geologist who would make a study of the region one million years hence, would find such a great contrast in the fossil remains enclosed in the strata laid down near the coast now and those after the uplift, that he would be constrained to refer them to separate periods in his geologic classification. Yet the climate and natural history conditions of the rest of the earth's surface may have remained unchanged, so that his divisions, based on the changes in Florida, would be of merely local significance.

But if the uplift, instead of being confined to the peninsula of Florida, were of continental extent, its effects would be far reaching and very important. With the extension of the land area, there would be an increase of the distinctly interior portion of the continent, whose climate, slightly different from that of the coasts, would have an appreciable effect on the flora and land fauna of the present coastal regions. The elevation of the continent, also, would lower the general temperature throughout its extent, driving southward the present north border of various temperate species of trees and other plants, and so changing the facies of the flora in any given locality. Such elevation of a very extensive land area, if thousands of feet in height, would have some effect on the climate of the entire earth, although just what this effect would be would depend largely upon the situation of the uplifted land with relation to the prevailing winds and ocean currents. But the most important manner in which the uplift would effect the natural history of the continent would be through radical changes of its soil and physical features. The low-lying, somewhat swampy plain, with its deep soil resulting from a long accumulation of the products of secular decay, would give place to a sharply dissected plateau, the steep hill sides and narrow crests of its individual ridges covered but thinly with a stony soil. While the effect upon the flora and fauna of any one change in conditions would probably be comparatively slight, the combined effect of all must be considerable, even if the uplift be but little. Indeed, it seems evident that not even the least change in the relation between land and sea can occur without somehow effecting the climate, and through it the life characters of the region in movement.

In an article entitled "The Relation between Baseleveling and Organic Evolution,[1] J. B. Woodworth discusses "the effect, on organisms, of the changes in physical geography which arise in the process of baseleveling." One of his most important conclusions is that the great change at the close of the Mesozoic era, from a characteristically reptilian to an equally characteristic mammalian land fauna, was due primarily to the great change in the physical features of the continent which is known to have closed the Cretaceous and introduced the Eocene period. The low-lying denudation plain of the later Mesozoic era was rapidly changed into the more elevated hilly land surface of the early Tertiary era. Toward the closing stages of Tertiary time, a peneplain had again been formed over a large portion of the continent, but it was not so perfect nor so extended as the previous one, and, hence, its effect upon organic life was less marked.

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[1] American Geologist, Vol. XIV, No. 4, October, 1894.

The main Tertiary or Tennesseean period of base-leveling in the eastern portion of North America was terminated by a slight seaward tilting of the continental plateau. A portion of the former land area was depressed beneath the sea, and on it was laid down a marine formation of red and orange gravelly loam—the Lafayette formation. The land on the alternative side of the axis of general deformation was slightly uplifted, thereby stimulating the streams to greater activity, which carried the products of rock disintegration into the neighboring sea to form the Lafayette formation. The soil and subsoil of the land area of that time were prevailingly of a red color, for had it been otherwise the Lafayette formation would not be so generally of that tint. Red soils are characteristic of lands whose climate is comparatively mild. The soils of the central and upper Mississippi basin, from whence chiefly was derived the red Lafayette loam of the Mississippi embayment region, are not known to have been of a decided reddish tint in the Quaternary era, except locally during the mild Aftonian interglacial epoch. On the contrary, the colors which almost exclusively dominate the deposits and buried soils of the Quaternary era are blue, yellow, brown and black. The fineness of the materials introduced by glaciation, the broad swampy flats, and the usually severe winter climate were the combined causes of the dark color of the Quaternary soils. None of these conditions were present in any marked degree during the Lafayette period, as the color and composition of the marine deposits and interior river gravels positively demonstrate.

The causes which produced glaciation not yet having begun to operate on the continent, the extension of the warm gulf waters to the head of the Mississippi embayment and the borders of the southern Appalachian province, must have introduced a milder climate into the upper and central portions of the Mississippi basin, providing no counteracting influences were brought to bear. The probable slight elevation of the continent northward from the Lafayette coast certainly did not possess sufficient power to modify the climate to any appreciable extent. Therefore, it seems evident that any change of climate in the eastern half of the territory now included in the United States, which may have accompanied the opening and culminating stages of the Lafayette epoch, must have been in the nature of increasing mildness instead of an increase in the severity of the climate. In short, so far as the climate is concerned, all the evidence which is at present known to exist is demonstrative of the practical continuance of Tertiary conditions to the close of the Lafayette epoch. Hence, those geologists who wish to include the Lafayette epoch under the Quaternary era, must base their claims on some other natural feature than climate. Mere earth movement, if its effects are not prominent, cannot be considered as instituting a new era, and, as the elevation of any part of America or the world at large in the Lafayette epoch is not known to have been great in vertical extent, and to have seriously effected climates, it can hardly constitute a legitimate reason for placing the epoch in the Quaternary era.

Immediately following the close of the Lafayette epoch there was a period of pronounced elevation of the continent. This is indicated by the valleys which have been eroded beneath the surface of the Lafayette deposits, by the great depth of the coastal valleys now submerged to form the fiords of the coasts of British America, Alaska, Scotland, Norway, Patagonia and other portions of the earth's land area; and no less truly though less definitely by the cañon valleys of the interior portions of the North American continent. The period of high-level continued to the opening of the Kansan epoch of glaciation, when, through some cause not rightly understood, but probably largely the great weight of the accumulating ice-sheet, the land in the eastern half of North America was depressed, and has remained to the present time at a much lower altitude than before the Kansan epoch. The high-level period or epoch just mentioned, seems naturally set apart both from the preceding low-level Lafayette epoch and the succeeding low-level Glacial epochs. It has, therefore, been defined as a geologic time unit and designated the Ozarkian epoch, from the fact that its results are so well seen in the sharp cut cañon valleys of the Ozark mountain and plateau regions of southern Missouri and northern Arkansas.

Although commonly considered as a unit, the Ozarkian high-level epoch was probably characterized by two main elevatory movements. The first began and ended at and very soon after the opening of the epoch, and was of great areal extent but not very marked vertical movement. To it, however, may be traced nearly all the recognized effects of the Ozarkian high-level condition of eastern North America. The second decided disturbance of the earth's equilibrium seems to have occurred very nearly at the end of the epoch. It was somewhat local in nature and effected most the northeastern portion of America, (and probably all the lands surrounding the North Atlantic). I must acknowledge that I am basing my claims for this elevatory movement on somewhat slender evidence. But the deep, narrow, now submerged valley channels in the border portions of the continental plateau off the mouths of such rivers as the Delaware and Hudson, certainly were not in process of excavation during the whole or even any large part of the Ozarkian epoch. They must be the result of a special elevation near the close of the epoch. And, further, the cañon valleys of the Mississippi basin sometimes have rock shelves buried under the present valley bottom. Often these rock shelves cannot be explained by any inequality of the strata excavated, but seem to indicate a renewed period of uplift near the close of the epoch. I may also add that those who, like the present writer, are inclined to find between the preglacial high-level of the eastern part of North America and the immediately succeeding glaciation a relation somewhat like cause and effect, see nothing at all improbable in the idea of a marked, comparatively rapid, local uplift of the regions afterwards glaciated.

The Ozarkian epoch, as already indicated, was terminated by the accumulation of the Kansan ice-sheet and the consequent depression of much of the land formerly elevated. It is here that most geologists wish to open a new era in the earth's geological history. There are, I believe, a number of objections to it. In the first place, glaciation, although effecting millions of square miles, was yet local when the entire land area of the globe is taken into consideration. Beyond the districts actually glaciated, it is often very difficult to accurately locate in a series of "effects" those which are chronologic equivalents of the opening of the Kansan epoch. A marked elevation of wide extent would, by reason of its having an observable effect on the streams of the disturbed area, and thereby modifying to a certain extent the erosion forms produced, be of vastly more utility in establishing a natural classification of time than a local accumulation of land ice. Furthermore, we have no evidence of any great change in climate, and hence in flora and fauna in the unglaciated districts at the opening of the Kansan epoch. Certainly the temperate species of animals and plants were driven away from the near vicinity of the ice, but to what distance we cannot say. Indeed, there is no probability that the change in the natural history conditions of regions not close to the great Quaternary glaciers at the opening of the Kansan epoch, was nearly as radical as that which must have resulted upon the withdrawal of the sea to beyond the present coasts and the general continental uplift and peneplain dissection which characterized the early stages of the Ozarkian epoch. If change of climate, of the physical features of continents, and of the geographic distribution of faunas and floras be accepted as the prime essentials in establishing a new era, the opening of the Ozarkian epoch has superior claims over the opening of the Kansan epoch.

The great geological eras are demarked by widespread unconformities and a radical change in sediment. As every effect has had a cause adequate to produce it, it may be assumed that these breaks in the sedimentary series were correlated with and directly dependent upon great changes of the land areas, usually of continental and often of almost worldwide extent. These changes were of the nature of great earth pulsations, uplifting and depressing the continental plateaux, and, when the contraction of the earth's crust was very severe, corrugating it and even, at times, fracturing it along certain lines of weakness. The new geological era thus instituted is usually considered to date from the time that the disturbance first assumed prominence, modifying the flora and fauna of the land areas and the nature of the sediment deposited in the sea about their borders. In short, it may be considered a rule that the natural opening event of the eras previous to the Quaternary as at present constituted, was a profound disturbance of the earth's equilibrium, and it does not seem to the writer that this rule should be set aside in subdividing the later geological history. Therefore, convenience and the need of a classification based strictly upon natural conditions, seem to demand that the Ozarkian epoch should be included under the term Quaternary era.

If we accept the above proposed innovation on the generally accepted scheme of geologic time divisions, we are constrained to reconstruct the previously established Quaternary classification. For it will soon become evident that the time of Ozarkian high-level of the continent deserves more than a mere recognition as an epoch equivalent in significance to any one of the succeeding glacial or interglacial epochs. It was pre-eminently a time of comparatively elevated conditions of the land *without glaciation.* Succeeding it was a period characterized by alternating glacial and non-glacial conditions, rapid epeirogenic movements, repeated migrations of faunas and floras, but no long continued high-level conditions. In point of time the former or Ozarkian period or epoch was by far the longer. This is graphically illustrated by the vast difference in the amount of valley erosion accomplished during the two periods. Although the glacial epochs are usually considered to have been accompanied by increased precipitation and other favorable conditions for rapid erosion, the valleys then excavated are quite insignificant as compared with the Ozarkian valleys. More erosion was accomplished in certain districts during the Aftonian interglacial epoch than during the combined Kansan, Iowa, Toronton ? and Wisconsin epochs. Yet the Aftonian rock gorges never approach in size the Ozarkian valleys of the same region. In fact, any one who has studied the Ozarkian valleys of the southern Appalachian, the Ozark and the upper Mississippi regions, and compared them with the results of post-Kansan erosion in such districts as western Illinois and northern Missouri cannot fail to be impressed with the fact that the time which has elapsed between

Quaternary Era	Recent Period		Modern Epoch—Flood plain deposition.
			Terrace Epoch—Valley erosion.
	Pleistocene Period	Glacial division	Wisconsin Epoch—Drift deposition.
			Toronton ? Epoch—Valley erosion.
			Iowan Epoch—Drift deposition.
			Aftonian Epoch—Valley erosion.
			Kansan Epoch—Drift deposition.
		Ozarkian division	Ozarkian Epoch—Valley erosion.

the close of the Lafayette epoch and the opening of the Kansan epoch was longer than all the time since. If we do not adopt any very large factor of safety, the known evidence will imply a length of time for the Ozarkian period twice and, perhaps, thrice as great as all subsequent time. Therefore, by reason of its length and other features in some respects peculiar to it, the Ozarkian period, or more properly sub-period, may be considered co-ordinate with the Glacial sub-period, the two to constitute approximately equal divisions of the Pleistocene period as in the table on page 113.

THE POCKET, OR POUCHED GOPHER.

(*Geomys bursarius.*)

BY CLEMENT L. WEBSTER.[1]

In passing over the beautiful prairies of the west, especially in portions of Iowa and southern Minnesota, the attention of the traveler is arrested by the great number of isolated or grouped mounds, which are seen over the surface.

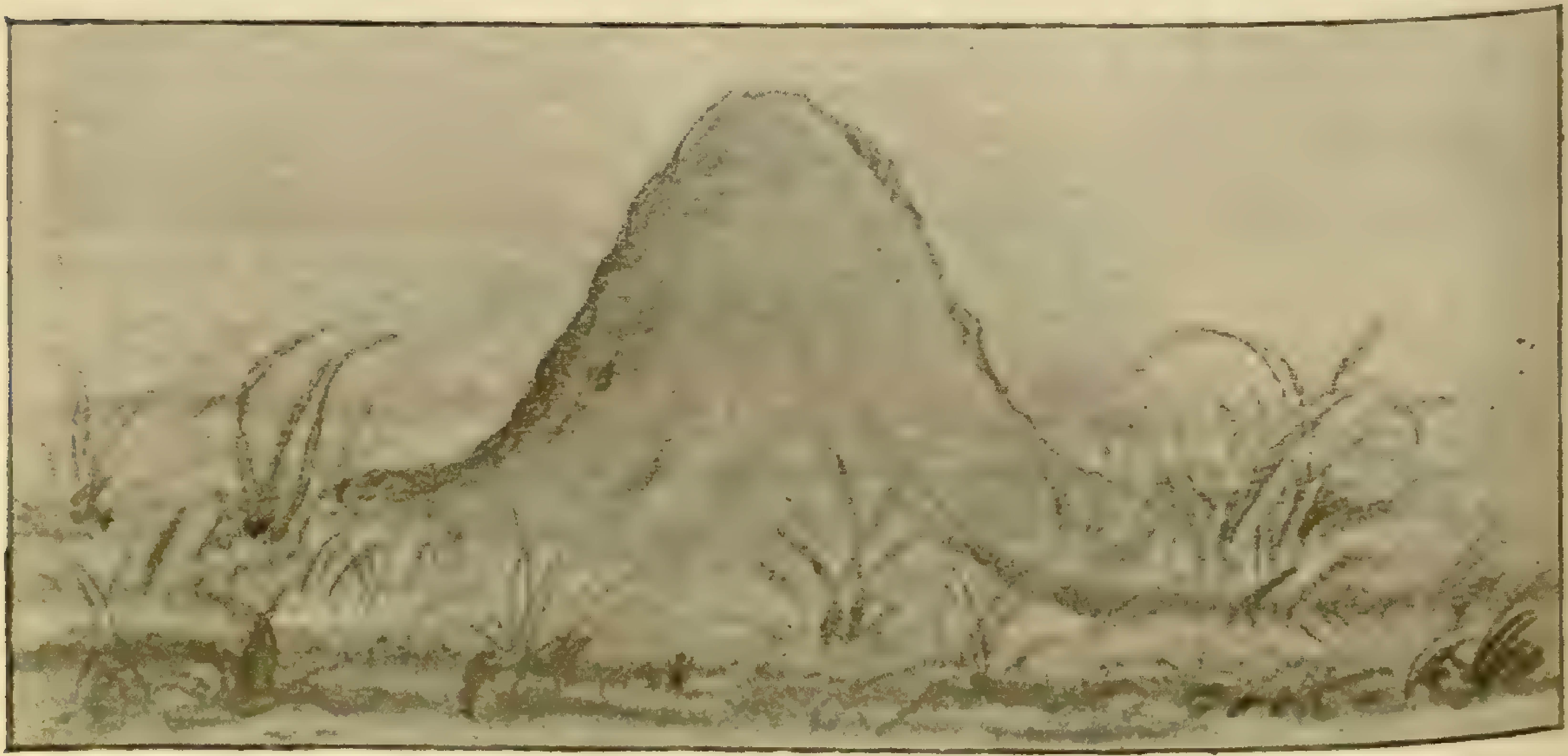

FIG. 1. Geomys bursarius.

These mounds are generally circular, and have a rounded or flattened top; and a diameter, at the base, of from four to twenty feet; and usually rise to a height of from one to three feet.

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[1] Charles City, Iowa.

PLATE VI.

Geomys bursarius.

Although the marginal outline of these mounds are usually circular, still, some of them are oblong, or have a gently flowing contour.

These mounds are isolated from five rods to one mile from one another, or are closely and irregularly grouped, or arranged in rude circles, semicircles, or even straight lines.

In some instances, we have counted as many as sixteen of these mounds in an area containing about two acres.

The locations of these mounds are exclusively in the prairie regions, and may be found on either high and dry, or on low and rather moist land. In Iowa and Minnesota, where I have devoted considerable study to these "peculiar mounds," they may be seen for many miles over the level prairies.

By far the greater number of these mounds owe their origin to the Pocket Gopher, (*Geomys bursarius*), which, year by year made additions to them by the dirt brought forth in the extension of their underground channels, until they finally assumed the proportions now seen.

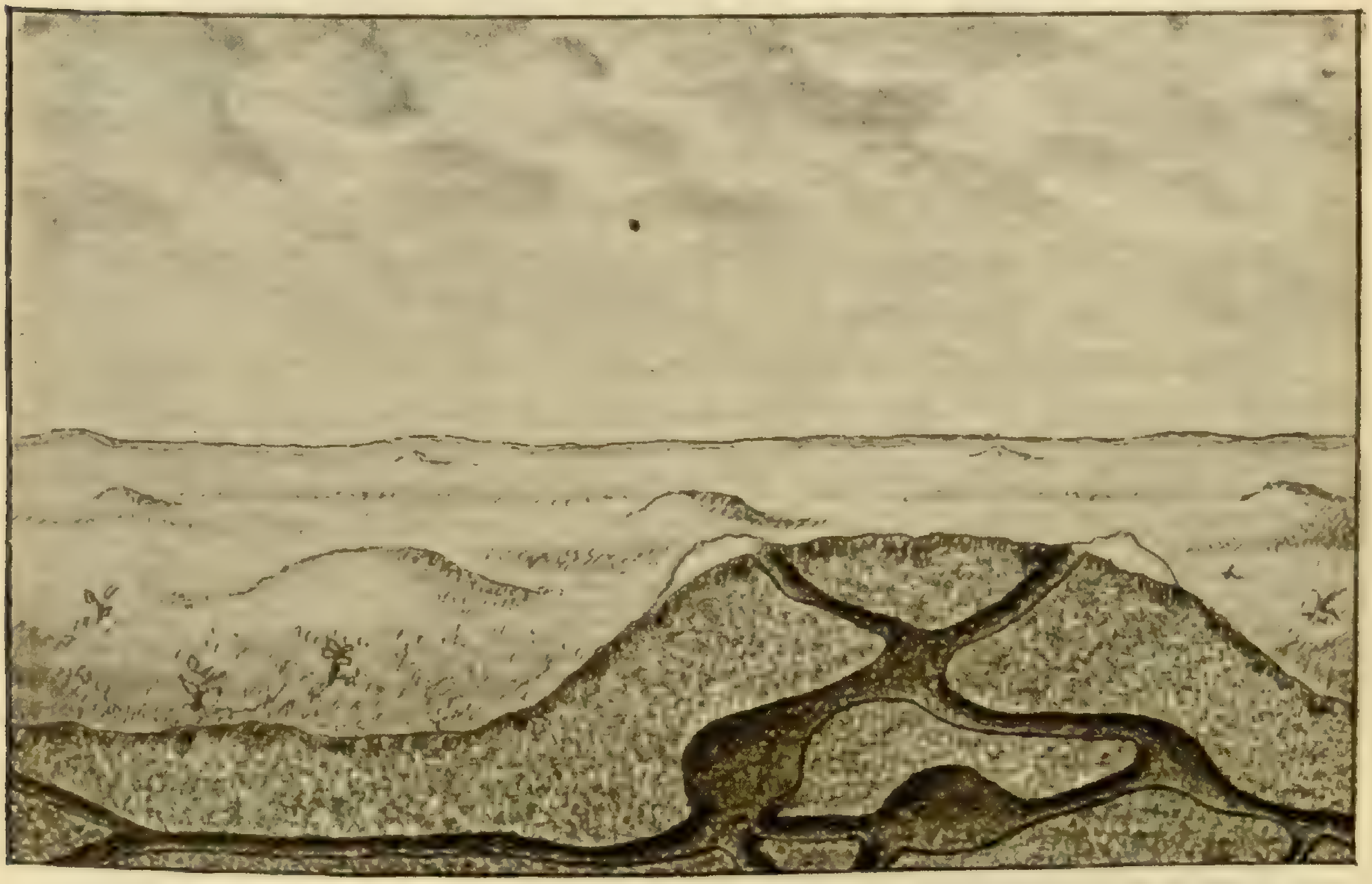

Fig. 2. Geomys bursarius.

Upon the death of the animal, or for some other cause, these mounds, and channels, were finally abandoned, and the mounds left to be taken possession of by the indigenous plants of the region, which are always, under such circumstances, of much ranker growth than is usual under other conditions.

Although I have been a resident of Iowa for more than twenty-eight years, yet comparatively few of the mounds under consideration have been reared by these Rodents during that time.

The question may arise: If nearly all these structures (which are very numerous) are the works of *Geomys bursarius*, why are there so very few of them in process of erection to-day.

To this query, we conceive of but one or two satisfactory replies; and this is: In the somewhat remote past, this species reached its culmination, or greatest expansion, in the regions under consideration; and that to-day witnesses its final decline; or else, that for an indefinite time in the past, this animal was a resident here, the mounds witnessing to their long abode, and upon the advent of the white settlers and the breaking up of the wild prairie lands, its mound-building propensities, or habits, was, to a considerable extent, modified.

Instead of erecting these great mounds to-day, this animal usually throws up little hillocks of earth, as described farther on in this paper.

One instance of what I may call the early mound-building propensity of this animal, was observed some years ago by the writer on his fathers farm near Rockford, Iowa.

First there was thrown up a small hillock of the usual size and appearance; and this was added to year by year (apparently by the same animal) until a conical mound three and one half feet in height and perhaps five feet in diameter at the base, was reared; when for some cause the animal ceased to work here.

In this instance several small mounds or hillocks were seen in the vicinity.

In fig. 1 is shown a sketch of this conical mound as last seen by the writer.

Some of the early writers on this subject have supposed that the great mounds of the prairies referred to, represent the ruins of ancient "muskrat houses" the builders of which existed here when the country was far wetter than now—in fact when the country was almost one great "slough."

Others believe them to be the "burial mounds of the Indians;" while still others of these writers attribute their origin to various causes.

In Fig. 2 is given a sectional view (and it conveys a good general idea of internal structure of nearly all of them) of one of these mounds as explored by the writer.

In nearly all cases the old, and sometimes recent, nests of this animal is found in the large expansions of the burrows in the mounds; with sometimes the decayed remains of stored food.

In a few cases it has been found that this animal has in recent times, taken up its abode in these mounds and here reared its young.

In one case, in 1895, near Rockford, Iowa, there was found in one of these mounds what was pronounced to be human bones, by a Physician at Rockford.

As to the correctness of this identification, however, I am unable to state, not having personally examined the relics. If, however, they were undoubted human bones, they then simply represent an intrusive Indian burial here during the early days of the country.

As a general rule, no small hillocks are thrown up by the Pocket Gopher, or seen near, the large mounds herein treated of.

The Pocket Gopher is usually considered a great pest; although not altogether because of the quantity of grain, etc., eaten.

They do not often destroy much grain by eating it, though they not infrequently get into a shock of wheat or barley and eat the heads of a few bundles and cut the bands of many others, and raise little hillocks in the shocks, from seven to fourteen inches in height and ten to twenty inches in diameter.

Considerable damage is done by this animal in gardens, both by eating the vegetables and covering many others with their mounds of earth. "When their holes run through a hill of potatoes, they always clean out the hill." "Sometimes they do noticeable damage in a patch of potatoes."[2]

The greatest damage done by this Gopher, however, is in covering small grain and grass with the earth they throw from their holes; the injury done in this way, is, in some sections, considerable.

During the latter part of March (1889), I counted, near Rockford, Iowa, ninety hills, from five to nine inches in height and one to three feet in diameter, thrown up by these Gophers in a field of Clover and Timothy. These mounds were all located in an area four by five rods in extent.

Their channels are at times quite straight for some distance; but most usually they frequently bifercate, or are somewhat tortuous.

Little hillocks, averaging from five to eight quarts of earth each, are brought to the surface, along the line of work, at irregular intervals; the distance between them varying from twelve inches to five feet. At other times only a single hillock will be observed in the vicinity; the animal filling the burrow behind him as he pursues his nocturnal way. If any channel be opened, which has even been closed for a long period, it will most usually be filled again very soon, by the Gopher; thus showing that, generally, all the underground galleries are frequently traversed by their inhabitant.

The burial mounds of the prehistoric inhabitants of Iowa, are frequently taken possession of by these Rodents, and the bones of the interred often gnawed; thus giving rise to the supposition, in the minds of some, that this evidences to the cannibalistic habits of the originators of these monuments. This species lays up large stores of food for winter, such as corn, wheat, buckwheat, and other grains, as well as roots and stems of weeds, which are usually cut up into short pieces.

The store of food laid up, is generally much greater than is used. Under straw-stacks, on western farms, where the soil is not frozen, this Gopher sometimes works all winter.

It is stated by Mr. Bailey (*loc. cit.*) that "Pocket Gophers work mostly by night." So far as my personal observations extend,

[2] Vernon Bailey, U. S. Agricultural Report, 1887,p. 448.

however, it is shown that fully as great an amount of work is done by this animal during the day, especially in the early morning, as is done at night.

It is also observed by the same author, that " in the spring many of them leave their holes and travel above ground."[3] In only two cases do I recollect having observed this animal traveling in this way.

In one instance (during an open winter) an individual of this species was found by me traveling through the snow in February. At another time, an individual was observed (during a cold winter) traveling aimlessly about over the deep snows, during the latter part of February or the first of March. In both cases, these Gophers were observed near Rockford, Iowa.

Dr. C. Hart, Merriam, chief of the Division of Ornithology and Mammalogy of the U. S. Department of Agriculture, whose exhaustive and attractive works on the Pocket Gophers and other subjects in natural history entitles his statements to the highest consideration, says, regarding the general belief existing that the Pocket Gopher use their cheek pouches to " cart dirt" from their burrow's. " These cheek pouches are used exclusively in carrying food, and not in carting dirt as is often erroneously supposed." (See p. 17; North American Fauna; " Monographical Revision of the Pocket Gophers)."

Mr. Vernon Bailey, another eminent naturalist of the U. S. Department of Agriculture, says, regarding the same subject. " Although it is commonly supposed that the pouches are used for carrying dirt out of the holes, the fact is they are never used for this purpose. " In examining the pockets of more than a hundred specimens caught in traps I could find no evidence that they had been filled with earth. Occasionally specks of dirt from roots clung to the hairy inner surfaces, nothing more. If the pouches had been filled with earth, the short hairs would inevitably retain some of it. Furthermore, Gophers shot in the very act of pushing dirt from their holes had none in their pouches." (See p. 15, Bulletin, No. 5, "The Pocket Gophers of the United States)."

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[3] The statements of this author are doubtless eminently correct, when applied to the species in the region he had under consideration (Elk River, Sherburne County, Minnesota); although apparently not applicable to the same species in the regions considered in this paper.

The writer has, however, on several occasions in northern Iowa, observed this animal (*Geomys bursarius*), to carry dirt out of its burrow in its cheek pouches, and eject it in exactly the same manner as Dr. Merriam describes their method of emptying their cheek pouches of food, which is as follows: The fore feet are brought back simultaneously along the sides of the head until they had reached a point opposite the hinder end of the pouches; they are then pressed firmly against the head and carried forward. "In this ways the contents of the pouches are promptly dumped in front of the animal." (See p. 19, Monographical Revision of the Pocket Gophers.)

This action of the fore feet is also apparently accompanied by some muscular action of the cheek pouches themselves.

This act of carrying dirt in the cheek pouches, I have personally observed, and several times killed the animal while in the very act, and have with my own hands completed the operation. I am not, however, prepared to say that this is really a constant habit of this species in northern Iowa.

It seems scarcely possible that so high authorities and keen observers as Dr. Merriam and Mr. Bailey should be deceived in their observations of the habits of this species in this respect in the regions they have studied; so we may consider their statements when applied to those regions, as eminently correct.

PHOTOGRAPHING CEDAR BIRDS.

BY DR. R. W. SHUFELDT.

It is now over five years ago since the writer in THE AMERICAN NATURALIST invited the attention of photographers to the value to science of first-class photographs of living animals, taken in natural attitudes, so that they could be used as study-models for artists and taxidermists.[1] Since contributing that article, and during the intervening period, not a little of my time has been spent in perfecting methods by means of which serviceable photographs could be made of the class of subjects just mentioned. Most of these experiments, however, were made last summer, and, upon the whole, with a degree of success far beyond my most sanguine hopes and expectations. From living specimens, and with the animals for the most part life size, in natural attitudes, and with natural surroundings, there have been obtained by me excellent photographic pictures of Opossums; White-footed Mouse (*Peromyscus leucopus*), in the act of jumping; Turkey Buzzard (life size head); nest and two young of *Icteria virens* (life size); also the same of Prairie Wabbler; Indigo Bird; Wood Thrush (*Turdus mustelinus*); Chipping Sparrow; Cat-birds; Red-eyed Vireo; several woodpeckers (mostly life size); various species of bats (life size); many snakes, lizards, hylas and toads; bumble-bee and flowers; and others too numerous to mention. Many of my photographs, too, not in this list, have been published, and appeared in various places.

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[1] SHUFELDT, R. W. Where young amateur photographers can be of assistance to Science. THE AMERICAN NATURALIST, V. XXV, No. 295, Phila., July, 1891, pp. 626–630. Plate XIII, Figure 1.

My success with some of the birds was extremely gratifying, and I have succeeded not only in obtaining many beautiful pictures, but likewise a number that are in my opinion more truthful portraits of their subjects than any of the ordinary illustrations we usually see of them in zoological works and text-books.

Early last summer I had in my possession a pair of living Cedar Birds, and they were most gentle and remarkably tame. One of them is still mine, and is kept in a large cage in order that I may study the moult in that species, which process it is at this writing (October 11, 1896) passing through. During July, I also had a pair of nestling Cedar Birds, at the age they quit the nest. With these, as well as with the adults, I made many photographic studies. In my studio I obtained a fine, life size picture of the male, in a most animated attitude; the pair was also obtained, and were equally satisfactory. Out of doors the operation is far more difficult, and the effort to secure the young was rewarded with but partial success, while in taking the adults under nearly the same conditions, a much better result was obtained. When I say nearly the same conditions, I mean that the young were attempted out in the open, were nothing obstructed the rays of the afternoon sun; while the old birds were tried in a piece of woods, where the light was nicely moderated by the shade of the trees. It is a reproduction (by the half-tone process) of this last picture that I desire to bring before the reader in connection with the present contribution. It was secured in the middle of the forenoon of a bright summer's day, under the following general conditions, to wit: by means of a large sheet of buff-colored blotting-paper the view was cut off beyond a small branch of poplar; this latter was next focused upon, and the camera made steady; next, the pair of birds were allowed to alight upon the limb at that part of it seen upon the camera's ground-glass. With closed shutter, and sensitive plate ready for an exposure, the proper moment must now be intently watched for, and with the pneumatic bulb in your hand, absolutely nothing must distract your attention, if you have any hope of obtaining a picture worthy of the name. Observe the light *most closely;* see to it that there is not a breath of air moving when you are ready to expose; make no sudden movements whatever, or your birds may, and likely will, quit the limb; let them become accustomed to their surroundings; and, finally, let your patience be absolutely inexhaustible. Thus it was I stood when I made the exposure—the male bird quietly assumed the attitude seen in the plate; while the female, with her back towards me, extended her neck to its fullest length (in that peculiar way these birds have), and slightly moved her right wing to avoid the annoyance of a couple of leaves that touched her shoulder. The diaphragm had but an eighth of an inch aperture, and the time was two seconds. One of the most difficult things to control in the out-of-door photography of small, wild animals is the light. It is not only the black, shiny bills of birds and backs of beetles that will take pure white, if they get the full benefit of the sun's rays during the exposure, but many other structures will produce the same undesirable result. Before I had much experience with this tricky factor I met with many disappointments, and ruined upon one occasion nearly an entire box of the best plates in my endeavor to secure a picture of a pair of nestling Pewees (*Contopus virens*) in their nest. In the pictures the birds looked as though they had been *snowed on*. Cutting off the light from above in a later attempt rectified this defect. One good way to study the effect of the light, is upon the ground glass of the camera, when the subject has been carefully focused upon it—and I think it will be found a safe rule in many cases to make the exposure when a light cloud partially veils the sun's face. All such matters, however, can only be gained by experience; and to pass through this, the best of all schooling, one must be pre-armed with an enormous stock of the best kind of patience, with a slight reserve fund of the same article on hand in the event of a run upon the original supply.

The picture of the Cedar Birds taken in this way is reproduced in Plate I, January number of the NATURALIST.

THE BACTERIAL DISEASES OF PLANTS: A CRITICAL REVIEW OF THE PRESENT STATE OF OUR KNOWLEDGE.

BY ERWIN F. SMITH.

(*Continued from p. 41.*)

VI.

III. THE POTATO (SOLANUM TUBEROSUM L.)

1. THE GAS-FORMING WET-ROT OF THE TUBERS (1891).

(I) THE DISEASE:

(1) *Author, Title of Paper, Place of Publication, etc.*—This disease was studied by Dr. Ernst Kramer in 1890–91. His paper, entitled (40) *Bakteriologische Untersuchungen über die Nassfäule*

der Kartoffelknollen may be found in *Oesterreichisches landwirtschaftliches Centralblatt*, Jahrg. I, Heft 1, 1891, pp. 11–26, 2 text figures.

The rot of the potato has been known to the agriculturist for a long time and was described by Julius Kühn as early as 1830. Since that time it has been noticed or written upon extensively by many persons, *e. g.*, de Bary, Hallier, Reinke and Berthold, van Tieghem, Sorauer. For a time owing chiefly to the writings of de Bary, its ravages were confounded, especially in the popular mind, with those due to the potato mildew, *Phytophthora infestans*, but it has no necessary connection with this fungus although in Europe, at least, it usually follows the latter. Prior to Dr. Kramer's investigation the organism associated with the rot was usually considered to be *Bacillus amylobacter* van Tiegh. and this was supposed to be the same as the *Vibrion butyrique* of Pasteur, *Bacterium navicula* Reinke and Berthold, *Amylobacter clostridium* Trécul, *Bacillus butyricus* de Bary and *Clostridium butyricum* Prazm., but no one had approached the problem from a purely bacteriological standpoint using approved methods of isolation and inoculation.

The object of the author in undertaking this series of experiments was to determine first of all whether the wet rot was actually due to bacteria and, if so, how they gained entrance into the tuber; second, to identify the species and determine its morphological and biological peculiarities; third, to determine what decompositions it was capable of producing in the potato and in other substrata. Owing, says Dr. Kramer, to the fact that several bacteria cause the butyric fermentation and several color blue with iodine and agree in morphological particulars more or less closely with *Clostridium butyricum* Prazm. (*Bacillus butyricus* de Bary) "it appears still very questionable whether the specific cause of the wet rot is *C. butyricum* Prazm., especially as the predicated cause was not studied critically in relation to its morphology and biology by the above named investigators [Reinke and Berthold, van Tieghem, Sorauer]."

(2) *Geographical Distribution.*—Potato rot occurs in many parts of the world, in fact almost wherever the potato is cultiv-

ated, but by no means all of it is due to the particular organism isolated by Dr. Kramer, as the writer of this review has proved conclusively (see next review). Considering the readiness with which almost all bacteria grow upon cooked potatoes it seems not unlikely that even in its natural state the potato tuber may offer a suitable nidus for the growth of a variety of bacteria especially when it is kept unduly warm and moist. However, this may be, only two bacterial diseases of the potato have been worked out conclusively. The distribution of Dr. Kramer's wet rot of the potato is not known. Very likely it occurs in North America as well as in Europe but no one has established this fact, probably because no one has searched for the organism, his paper having been very generally overlooked. Even the European distribution of this rot is a matter of much doubt as it has probably been confused with the brown rot due to *Bacillus solanacearum.*

The potatoes from which were derived the bacteria used in these experiments came from the vicinity of Graz where the wet rot was very destructive in the autumn of 1890.

(3) *Symptoms.*—Under the influence of this disease the contents of the tuber becomes soft, pulpy, vile-smelling, and usually of a yellowish color. The disease may either attack the tubers before they are harvested or during the winter in the store houses. If one of these wet rotten tubers is pricked or squeezed a fluid pours out which has a strongly acid reaction and a very bad smell, mostly like butyric acid. Gas bubbles are also frequent. The remaining pulp, which is rather compact, gives an alkaline reaction either immediately or after a short time. This reaction is plainest in the tissues which have already become completely pulpy. At the commencement of the destruction of the potato while the tissue is still firm, the reaction is moderately acid.

The tubers forwarded to Dr. Kramer for investigation possessed all the above mentioned characteristics of wet rot. They still had a plump look. The skin was apparently uninjured but the whole potato was a bloated sack with a yellow ichorous contents. When punctured a very bad smelling, sour fluid escaped. The smell recalled butyric acid and amin bases (trimethylamin). In some cases the escaping juice as well as the remaining pulp gave at first an acid reaction and subsequently an alkaline reaction.

(4) *Pathological Histology.*—Under the microscope the fluid pulp appeared to be composed of starch grains, single cells of the potato, or groups of such cells, fragments of cell walls, remnants of protoplasm, and countless numbers of bacteria, chiefly in the form of bacilli, These measured 1.5–5.0 x 0.8μ, and were actively motile. Frequently they appeared as though composed of non-septate threads, or were in chains. The single rods were rounded at the ends, while not rarely the longer threads appeared to be narrowed toward the extremity (zugespitzt). Ellipsoidal forms, 1 x 2μ, appeared regularly among these bacilli. A roundish, strongly refractive body was visible in the protoplasm of these ellipsoidal forms. This represented the beginning of spore formation, as was shown by later and more exact investigation.

(5) *Direct Infection Experiments.*—No direct infections.

(II) THE ORGANISM: Described as a bacillus but not named.

I have been in the habit of calling this organism Kramer's potato bacillus, and until such time as it can be re-studied and carefully compared with other gas and acid producing species it is probably best that it should remained unnamed. Some critical student of the species is certainly the only one who has any right to name it. We have had altogether too much of naming things without study, *i. e.* on the strength of the imperfect descriptions of other writers.

1. *Pathogenesis:*
   - (A) Yes.
   - (B) Yes. This was accomplished in the following manner. Wet rotten tubers having the skin still uninjured were cut open with sterilized knives and small quantities of the fluid pulp were transferred by means of a sterilized platinum loop into flasks closed by cotton plugs and half full of distilled, sterilized water, which was then well shaken to distribute the bacteria. To obtain a proper dilution definite quantities of this infected water were transferred to similar flasks, each

half full of sterilized water. From these second dilutions, the inoculations were made. The bacteria were isolated by the poured plate method, dextrose-peptone, nutrient gelatine being first used as a substratum, and subsequently nutrient glycerine agar which proved very satisfactory.

(C) Yes. The method of infection was as follows. The bacillus was first cultivated in a variety of fluid media until a suitable one was found. A watery potato juice with the addition of 1–2 per cent dextrose was finally selected as most suitable, the bacillus developing better in this than in any other medium. This broth was made as follows: Fresh potatoes were reduced to pulp and digested for some hours in cold water. The fluid was then filtered out and the dextrose added. The filtrate was then boiled, filtered again, and finally sterilized in the ordinary way under cotton plugs. A series of glass dishes (Präparatengläsern), about 8 cm. deep and 10 cm. broad, were filled half full of this broth. These dishes were closed by corks having a short, cotton-plugged glass tube passing through them. The vessels with the enclosed nutrient fluid were then sterilized by discontinuous heat. The potatoes to be tested were selected with great care, and their surface was sterilized as far as practicable in the following manner. These living tubers were first cleaned mechanically, then plunged for some minutes into a solution or mercuric chloride, and finally washed repeatedly in sterilized, distilled water. In this way some of the tubers (not all of them) were rendered completely sterile. The tubers were then placed in the sterilized broth in the glass dishes, the mass of the fluid having been so chosen that when the sterilized tubers were in place they were entirely covered by the broth. The fluid was then inoculated with small quantities of the bacilli, derived from pure cultures, by removing the cotton plug from the glass tube for a moment and inserting the germs on the end of a sterilized platinum wire. The vessels were then placed in a brood oven at a temperature of 35°C. Within 12 hours the nutrient fluid became very turbid and began to give off gas bubbles rapidly.

After 8 days three vessels were opened and the potatoes taken out. Tubers and broth were examined immediately. In places the skin of the tubers exhibited folds and the tissue underneath appeared to be soft. When these spots were cut out and examined microscopically the entire tissue was found to be honeycombed, the intercellular substance being strongly swollen or entirely dissolved, the cell membranes wholly or partially destroyed, and the starch grains free in places.

After 14 days more vessels were opened and the potatoes removed. Under the skin of these tubers there were very soft spots and exact investigation showed that in these places the tissue was almost entirely destroyed so that great cavities were formed. The softened tissues surrounding these cavities gave a faint acid reaction and contained numerous bacteria.

Finally, after 20 days, the remainder of the potatoes were removed from the broth and examined. By this time the appearance of these tubers had entirely changed. They consisted only of bloated sacks filled with a half fluid pulp. Exactly as in case of the original wet rotten tubers the contents consisted of free starch grains, single cells and groups of cells, cell membranes, remnants of protoplasm, and myriads of bacteria. The fluid pulp gave a strongly acid reaction and had a smell like butyric acid. When such tubers were pressed, gas bubbles came out. Taken out of the nutrient fluid and kept in a damp chamber at 25°C., the tubers rapidly underwent a still further decay. After 12 hours the smell of butyric acid disappeared and the tissues showed a strong alkaline reaction, accompanied by a smell recalling ammonia and amin bases.

Checks did not develop this rot. In sterile water they either remained sound for weeks or else, in case the skins were not thoroughly sterilized, contracted a different kind of decay, due chiefly to *Bacillus fluorescens.*

(D) Yes. In case of the tubers which were in the fluid 8 days the softened spots contained large numbers of bacteria (bacilli), which, when critically examined, turned out to possess all the morphological and biological characters of the bacteria obtained by pure cultures from the wet rotted potatoes, and from which the nutrient solutions had been inoculated. At the same time that the tubers were examined the solutions were subjected to an exact bacteriological investigation. In two instances no other bacteria were found in them than the sort which had been put in purposely. In the third case, several other bacteria were present, indicating that the skin of the tuber had not been completely sterilized.

In case of the tubers which remained in the fluid 14 days, the bacteria in the softened tissue around the cavities were isolated and found to be identical with those used for inoculating the fluid. In two cases also, only the inoculated form was obtained in cultures made from the nutrient fluid surrounding these tubers, and consequently there could be no doubt that the destruction of the tissues was due to these bacteria. Similar cultures were made from the tubers left in the broth 20 days, and with the same results. When cultivated out, the bacteria swarming in the rotten tubers proved to be morphologically and biologically identical with the form originally inoculated into the nutrient solution in which the tuber lay, and from which alone the infection could result. In brief, the previously sound potatoes became infected and wet rotten as a result of the action of the bacteria introduced into the nutrient solution, and these bacteria had been previously cultivated pure from wet rotten potatoes.

Conclusion.—Pathogenic nature clearly established.

Remark.—"The objection may perhaps be raised that the artificially induced wet rot, just described, did not begin with infection from without, *i. e.* from the nutrient solution, but that bacteria were present in the apparently sound tissue of the potatoes used for the experiment, *i. e.* foci of infection dating from the harvest time, which later on with higher temperature and sufficient moisture, developed further. In opposition to this it may be stated, first, that the potatoes used in the experiment came from a locality in which, in previous years, wet rot had not appeared; and, second that the tissue of several of these potatoes was tested for the presence of bacteria, but always with negative results. The infection was also transmitted to sound tubers by puncturing them with a sterile platinum wire and then inserting into the stab a slight quantity of a bacterial, pure culture. These tubers were kept in a damp chamber at 35°C. The decay of the tuber, which always proceeded from the inoculation puncture, was identical with that of the wet rotten tubers. The wet rot of the potato tuber is, therefore, nothing but a decomposition of the same induced by a particular species of bacteria. Sorauer, and van Tieghem performed similar experiments but these differ from my own in that the investigators I have mentioned worked neither with bacterial pure cultures nor with sterilized tubers and sterilized nutrient fluids."

There is another objection which does not seem to have occurred to Dr. Kramer, viz., that the tubers which rotted were exposed to abnormal conditions. They were either submerged or placed in very moist air and quite likely deprived of their vitality through lack of aeration. They were also exposed to an unusually high temperature. Under these conditions, which would occur in the potato fields only exceptionally as the result of exceedingly hot weather and of very frequent or very prolonged rains, possibly many other organisms, which are usually saprophytic, might enter and destroy the tubers, lying in the warm, wet earth. This seems to be established by Dr. Kramer's own experiments (see last paragraph under (II) 1 (C.). He has shown clearly that the species in question will produce wet rot, but not that many other species would not also produce it under like conditions. A much severer test of the parasitic nature of this organism would be the inoculation of the growing leaves and stems of the potato under normal conditions of temperature and moisture, simply by means of needle pricks. Under these conditions it is possible the organism might be shorn of much of its power or refuse to grow altogether. The determination of this point offers an interesting field of experiment for some one.

2. *Morphology:*

(1) *Shape, size, etc.*—This organism is described as a Bacillus. It forms rods 2.5–4.0 x 0.7–0.8 μ. On gelatine and agar plates chains are common, as are also apparently non-septate threads which frequently reach a length of 16 μ. and more. In nutrient fluids and on potato the rods are for the most part shorter, *i. e.* 1.5 to 2.0 μ. long. The rods are rounded at the ends. The threads taper off and are wavy. Spindle-shaped organisms could not be found.

(2) *Capsule.*—No mention of any capsule.

(3) *Flagella.*—The rods are actively motile. No mention of flagella.

(4) *Spores.*—Thicker, ellipsoidal forms occur in old cultures. These are 1.3 x 2.0 μ. They have a strongly developed membrane and their plasma becomes differentiated and more strongly refractive. This is the commencement of spore formation. The mature spores fill the whole interior of the cell.

(5) *Zoogloœa.*—No mention of zooglœa.

(6) *Involution forms.*—No mention of any distorted forms.

3. *Biology:*

(1) *Stains.*—The vegetative rods take all the common anilin stains, and the spores may be colored very prettily by Neisser's method.

(2) *Gelatin.*—On plates of nutrient gelatin the organism forms dirty-white colonies, around the periphery of which the gelatin

liquefies allowing the colony to settle to the bottom of a pit. The funnel of liquefaction extends rapidly over large areas of the plate. Owing to this rapid liquefaction successful gelatin plates can be made only by very thin sowings. In most cases, the whole plate was soon liquefied at 25° C., if somewhat abundant sowings were made. In stab cultures, dot-formed colonies first develop along the track of the needle and finally fuse so that the stab appears as a thread. The liquefaction begins at the mouth of the canal and proceeds very energetically so that ordinarily in 48 hours at 25° C., the whole gelatin has become fluid. Streak cultures on nutrient gelatin are very characteristic. Within 12 hours the track of the needle appears as a raised dirty white line. The line spreads rapidly and widely to each side, forming a surface not unlike an elongated, irregularly margined leaf. Scarcely has this leaf formed when the gelatin begins to liquefy. Such streak cultures can be carried on only at room temperatures and with inoculations from cultures that have been grown on gelatin repeatedly; otherwise, the gelatin is liquefied too quickly.

(3) *Agar.*—On plate cultures of nutrient glycerin agar the organism forms small, dirty-white, slimy drops. When examined with a hand lens these appear to be round, have a sharp contour, and show in the interior a brownish center. In stab cultures the track of the needle appears as a thread, and the organism spreads from the mouth of the canal toward the periphery as a delicate layer (Auflagerung).

(4) *Potato, etc.*—On potato it forms a dirty-white, slimy layer, which at first gives an acid reaction, and then becomes strongly alkaline. The decomposition proceeds rapidly through the whole slice of potato, 2 to 3 days, at 25° C., being sufficient to involve the whole thickness. During this decay there is a copious evolution of gas from the interior, bubbles as big as a pin head bursting through the slimy covering and leaving in it little funnel shaped openings.

(5) *Animal Fluids.*—Judging from statements cited under *Pathogenesis* C., probably several were tried but there is no specific mention of anything but milk. In this fluid the organism caused the separation of the casein but no other

change. Unlike Hueppe's aerobic *Bacillus butyricus* it caused in the milk no formation of ammonia, leucin, tyrosin, and a bitter tasting substance, when kept at 25° C.,—not even after three weeks.

(6) *Vegetable Juices.*—This germ grew best of all in cooked potato juice to which 1–2 per cent of dextrose was added. At 35° C., this fluid became very cloudy in 12 hours and gas bubbles were given off.

(7) *Salt solutions and other Synthetic media.*—In dextrose solutions with addition of tartrate of ammonia or peptone and the necessary mineral substances (not stated what) the organism developed very satisfactorily with formation of carbonic acid and butyric acid. In a starch paste to which tartrate of ammonia and the common nutrient salts were added, the organism grew well but there was only a slight dissolving of the starch and no formation of butyric acid. For behavior in mineral solutions containing 5 per cent peptone see *Biology* 10 c.

(8) *Relation to Free oxygen.*—*Bacillus amylobacter* (*Clostridium butyricum* Prazm.), as is well known, grows only on exclusion of the air, and since the wet rot of the potato was generally attributed to this organism, Dr. Kramer first started anaerobiontic cultures. The inoculated nutrient dextrose-peptone gelatin was poured into plates and covered with films of mica. At the same time anaerobiontic cultures were started in Gruber's tubes, using dextrose-peptone, nutrient gelatin. The cultures were kept in a brood oven at 26° C. The colonies began to appear in 24 hours. On the plate cultures under the mica, after 48 hours, tiny colonies appeared which did not increase in size to any noteworthy extent. Colonies on the same gelatin, uncovered, developed rapidly, so that on the second day this was entirely liquefied. The liquefied gelatin smelled like butyric acid, *i. e.*, distinctly like sauer-kraut. In Gruber's tubes minute, dot-like colonies also appeared, but only a few of these developed any further. The larger colonies caused a circular liquefaction of the gelatin, 2–4 mm. broad and increasing but slightly. These experiments indicated that the organism is not anaerobic. A more careful examination of the

colonies in the Gruber's tubes showed that every colony buried in the gelatin was unable to develop further, and that only a few of the superficial ones reached a somewhat larger size and liquefied the gelatin. Evidently a slight quantity of oxygen remained in the tubes (it is impossible to pump out all the air) and this sufficed for the development of some of the colonies. The tiny, dot-shaped colonies under the mica, those in the Gruber's tubes, and those which produced liquefaction on the uncovered gelatin were then studied carefully and found to be all of one sort. They were bacilli agreeing exactly in their morphological characters with the rods which had been observed previously in the wet rotten tuber. That the dot-shaped colonies in the Gruber's tubes failed to develop further simply from lack of oxygen is best shown by the fact that after the opening of the tubes the growth of the colonies and the liquefaction of the gelatin proceeded so rapidly that within 12 hours the latter was completely liquefied, even at room temperatures.

(9) *Reducing and Oxidizing Power.*—In stab cultures in nutrient gelatin rendered blue by tincture of litmus, a confluent, dirty-white growth was formed in the canal, and at the same time the gelatin began to change from blue to red, commencing at the upper end of the stab. When this reddening had reaching the bottom of the tube the gelatin began to liquefy commencing at the upper end of the stab. Along with this liquefaction there was a complete bleaching of the litmus, the gelatin resuming its original yellow color. It could not be determined whether this reduction should be referred to removal of oxygen or to the liberation of hydrogen. Nutrient gelatin stained red by carminic acid was also entirely bleached by this bacillus.

(10) *Fermentation Products and other Results of Growth:*

(a) *Gas Production.*—The organism causes a copious evolution of gas from potato tubers, living or steamed; potato broth with dextrose; and dextrose solutions containing ammonium tartrate and mineral salts. This gas was determined to be CO_2. No mention is made of any hydrogen. Possibly some was overlooked.

(b) *Formation of Acids.*—The bacillus produces a strong acid reaction in solutions or substrata containing sugar, *i. e.*, in the potato; in steamed potato juice with addition of 1–2 per cent dextrose; and in dextrose solutions containing tartrate of ammonia and the necessary mineral substances; but not in starch paste with ammonium tartrate and the nutrient mineral substances, nor in peptone solutions containing nutrient mineral substances. This acid was determined to be butyric and in the following manner. The soft contents of a tuber in the first stage of rot while still acid, was extracted in water by boiling, filtered, and mixed with a small quantity of calcium carbonate. A white precipitate resulted, presumably of calcium butyrate. This was, consequently, filtered boiling hot. The precipitate which crystalized out of the liquid exhibited under the microscope the very characteristic rhombic prisms of calcium butyrate. When this salt was mixed with dilute hydrochloric acid a fluid resulted which was miscible in water, had a boiling point of 163° C., and possessed the characteristic smell of butyric acid.

(c) *Production of Alkali.*—In the second stage of the rot the tissues show a strong alkaline reaction. If a little of the soft contents of a tuber in this stage of the rot is mixed with a few drops of distilled water, the fluid filtered, and the filtrate mixed with Nessler's reagent, a decided brown color appears instantly, indicating ammonia. A part of this ammonia combines with the free butyric acid to form ammonium butyrate and the remainder serves to render the decomposed tissues strongly alkaline. The ammonia is attributed to the decomposition of albuminoid substances by the bacillus. As additional evidence, it is stated that if a 5 per cent peptone solution containing the necessary nutrient mineral substances be inoculated with a pure culture of this bacillus, a sort of rotting fermentation takes place, the first evidence of which is a strong ammoniacal smell. Nessler's solution indicates the presence of ammonia.

(d) *Formation of Pigment.*—Growth described as dirty-white on agar, gelatin, and cooked potato.

(e) *Development of Odors.*—As already stated, there is a strong odor of butyric acid in the first stage of the rot, and subsequently other bad odors appear. The latter are due to ammonia, methylamin, and especially trimethylamin. The existence of the amin bases was determined as follows. Methylamin was found by taking a little of the thoroughly rotted tissue, mixing it with water, filtering, and mixing the filtrate with platinous chloride, whereupon there resulted a green precipitate, $PtCl_2\ 2CH_3\ NH_2$. Trimethylamin was detected by adding to a second part of the filtrate acid (salzsaures) platinic chloride, the resulting orange precipitate consisting only of the well developed octahedrons of the corresponding platinic double salt. The formation of these amin bases is attributed to the action of the bacillus on the nitrogenous part of the substratum. They were also detected by the same methods in the above mentioned mineral solution containing 5 per cent peptone, and consequently must have been derived from the peptone. These substances may also be detected in old pure cultures of this bacillus in peptone nutrient gelatin.

(f) *Enzymes.*—No mention is made of any study of these bodies. The organism undoubtedly produces several since it is capable not only of peptonizing gelatin and of dissolving cellulose but also of attacking albuminoids. Starch is but little affected.

(g) *Other Products.*—See *Biology* 10e.

(11) *Effect of Dessication.*—No statement. Probably not readily injured by dry air. Forms spores.

(12) *Thermal Relations:*

(a) *Maximum for Growth.*—Not determined.

(b) *Optimum for Growth.*—Not determined. This germ grows well at 25° C., and at 35° C., apparently most rapidly at the latter temperature.

(c) *Minimum for Growth.*—Not determined.

(d) *Death Point.*—Not determined.

(13) *Relation to Light.*—No statement.

(14) *Vitality on Various Media.*—No statement. The organism forms spores.

(15) *Effect on Growth of Reaction of Medium (acid, neutral, alkaline).*—No specific statement. Organism will evidently grow in either acid or alkaline media.

(16) *Sensitiveness to Antiseptics and Germicides.*—No statement.

(17) *Other Host Plants.*—No mention of any.

(18) *Effect upon Animals.*—No mention of any tests.

(III) ECONOMIC ASPECTS:

(1) *Losses.*—Serious.

(2) *Natural Methods of Infection.*—The question at once arises: How is the disease spread in the field, the tuber being, as is well known, carefully protected from external injuries by a firm layer of cork cells. If this layer is not punctured or broken the tuber appears to be safe from parasitic attacks. Even when the bacillus was placed on the cut surface of a living tuber in the air of an ordinary room, Dr. Kramer found that it was never able to cause the disease, the tuber developing a protective layer of cork cells under the mass of bacilli before they could grow. The case was quite different, however, when tubers lying in the infected nutrient solutions were stabbed with a sterile platinum wire. When, after 8 days, such tubers were examined by cutting through the stab, the canal in most cases was found occupied by the bacteria, and the decay of the tissue was seen to have proceeded from this canal outward. If the cork covering was shaved off in any place, the infection ordinarily began there. There is, consequently, no doubt that in the presence of sufficient moisture the bacteria can gain an easy entrance if the corky covering of the tubers is injured in any way, and such injury, we know, is frequently brought about by insects. It is well known also that the lenticels open when potato tubers are exposed to moisture for some time, *e. g.*, in wet earth, and this readily accounts for the infection of uninjured tubers. Indeed, Dr. Kramer demonstrated experimentally that in apparently uninjured tubers lying in his infected broths the rot frequently began with a darkening and softening around the lenticels, these changes being visible within a few days. When such spots were examinsd it was found that the bacteria had already penetrated into the tissue

in considerable numbers. Dr. Sorauer attributed the infection of sound tubers to this cause and Dr. Kramer was thus able to confirm it.

(3) *Conditions Favoring the Spread of the Disease.*—There is nothing on this subject beyond the statement that potatoes rich in sugar would be attacked and destroyed sooner than those rich in starch. It is clear, however, that this disease is likely to be most prevalent in warm and wet autumns, high temperatures and excessive rainfall offering favorable conditions for its development.

(4) *Methods of Prevention.*—No experiments, and no observations. Disease not studied in the field. Of course, whenever warm, rainy weather occurs in autumn potato rot of some sort is likely to appear, and common sense would dictate the prompt digging of the tubers and their storage in thin layers in a dry place, otherwise the whole crop may be destroyed in the ground, or subsequently in the pit or cellar.

Remark.—In the later stages of decay *Bacillus fluorescens* is quite common, and one is also likely to find almost any of the common soil bacteria. This paper was announced only as a preliminary communication, but no second paper has been published, so far as known to the writer.

This organism differs from *Bacillus amylobacter* van Tiegh. (*Clostridium butyricum* Prazm.) in that the latter is strictly anaerobic, produces spores in spindle shaped cells and colors blue with iodine. *Bacillus butyricus* Botkin, which is thought by Lehmann and Neumann (**41**) *Bakteriologische Diagnostik*, Munich, 1896, Bd., II, p. 315, to be distinct from the preceeding, is also strictly anaerobic. *Bacillus butyricus* Hueppe differs from Dr. Kramer's organism in the way metioned above (II) 3 (5) in the absence of gas production, and in some less important particulars. A number of other butyric acid forming species have been described but all more or less imperfectly.

EDITOR'S TABLE.

WHILE the primary object of the University is instruction, there are several reasons why original research is of more than incidental importance to its prosperity. The mastery of his subject, which is characteristic of the man who advances the knowledge of it, is an essential of a good teacher. The belief in this truth is so general that the teacher who is known as a discoverer will more successfully attract students to his classes than he who is not so known. But, apart from this, the general reputation of a school before the public is more surely affected by the research work that issues from its faculty, than the managing bodies of some of them seem willing to admit. As an advertisement, successful original work is incomparable. It serves this purpose in quarters where the detailed work of the university is of necessity unknown. We know how it is with our estimate of institutions of foreign lands; we know them by the work of their professors in original research. We believe that those universities which permit of the production of original work by those of its professors who have proven themselves competent for it, are wise above those who do not do so. Those who load such men with teaching, so as to forbid such work, reduce their prosperity. We regret to learn that a tendency to the latter course is increasingly evident in some of our great schools. Who, in the chemical world, does not think the more highly of Harvard, on account of the work of a Gibbs; how much better is Brown known through the work of a Packard, and so on? Chicago, Pennsylvania and Cornell profit greatly in various fields by the work turned out by certain members of their faculties. Who does not know Columbia, Princeton and Johns Hopkins as the seat of the labors of men whose names are familiar to every American? Yet, in a few of these institutions, the prosperity brought by these very men is becoming the means of choking their vitality of these their life centers, by the increase of drudgery which it brings. The managers will be wise to preserve for these men sufficient leisure to enable them to advance the frontiers of the known, and thus to obtain juster views of things as they are, and to bring us ever nearer to a comprehension of the great laws, whose expressions it is their business to teach to the growing intelligences of the nation. By all means nourish the nuclei of the mental life, which will thus preserve the vitality of the cytoplasm of society, and protect them from being smothered by it into stagnation and ultimate crystallization.

PROFESSOR WOODROW WILSON delivered an address at the recent susquicentennial anniversary of Princeton University, which contained pointed reference to the energy displayed by the sciences in the field of thought and education at the present time. This reference not only pointed out what the sciences are not competent to do, but was distinctly uncomplimentary in its allusion to supposed evil-effects on the minds of its cultivators, which he characterized as " noxious gases which issue from the laboratory." Whatever Prof. Wilson's private views may be, his expressions in this address did not include those qualifying words which are in place in dealing with the subject from the point of view which is to our mind the broadest and best. If the sciences do not teach the humanities from the side of the ideal and the esthetic, they enforce them in sterner fashion by an exposition of the nature of necessity. We may also admit, that the humanities are not their field in general ; but they are none the less beneficial to thought as well as to practical life on that account. The scientific training appears to us to be of inestimable value, as supplying the habit of orderly thought, which must infallibly lead to the truth in whatever field it may be applied: Let the humanities flourish, but let then not decline the aid of the sciences. Together they constitute a working partnership, which embraces the field of human culture, and gives the mind all sides of reality, which includes not only " sweetness " but " light ".

RECENT LITERATURE.

Bailey's Survival of the Unlike.[1]—This new book from the facile pen of Professor Bailey consists of essays and papers all of which have been presented elsewhere, and now brought together in accordance with the author's plans. Thus while a collection of essays, it is not without unity. " In making these essays " the author says, " I have constantly had in mind their collection and publication and have, therefore, endeavored to discuss the leading problems associated with the variation and evolution of cultivated plants, in order that the final collection should be somewhat consecutive."

The following quotations from his very suggestful preface will give the reader a general idea of the author's position. " The underlying motive of the collection is the emphasis which is placed upon unlikenesses and their survival because they are unlike. The author also denies the common assumption that organic matter was originally endowed with the power of reproducing all its corporeal attributes, or that, in the constitution of things, like produces like. He conceives that heredity is an acquired force, and that, normally or originally, unlike produces unlike." The author's *a priori* reasons for belief in the hypothesis of evolution are "the two facts that there must be a struggle for existence from the mere mathematics of propagation, and that there have been mighty changes in the physical character of the earth, which argue that organisms must either have changed or perished." On the other hand, "the chief demonstrative reason for belief in evolution is the fact that plants and animals can be and are modified profoundly by the care of man."

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[1] *The Survival of the Unlike*, a collection of evolution essays suggested by the study of domestic plants, by L. H. Bailey. New York, The Macmillan Company, 1896, 515 pp., 8vo.

The body of the book is in three "parts," the first including essays touching the general fact and philosophy of evolution; the second, those expounding the fact and causes of variation; and third, those tracing the evolution of particular types of plants. The first essay gives name to the book. In it the author discusses (1) the nature of the divergences of plants and animals, suggesting the Mycetozoa as the point of divergence; (2) the origin of differences, holding that all plants and animals came from one original life-plasma which had the power of perpetuating its physiological but not its structural identity, no two organisms ever being exactly alike, it follows that unlike produces unlike; (3) the survival of the unlike, this being an extension of our notion of the meaning of the phrase "the survival of the fittest," by showing that the fittest are unlike.

The author gives us some interesting pages on the species dogma, in which he pointedly shows the inconsistency of those who demand experimental evidence of the evolution of a species, and yet reject "horticultural species" because they have been produced under cultivation. Many examples are given of the origination of well marked "varieties" which are much more different from the species from which they sprung than are the recognized species from one another. Here Professor Bailey's experience as a horticulturist enables him to cite striking examples of what the candid reader must admit are good species of beans (Phaseolus), tomato (Lycopersicum), maize (Zea), soy beans (Glycine), etc. The horticulturist who is familiar with the plasticity of plants, and who is accustomed to see new and persistent forms arise, cannot help being an evolutionist, nor can he help being impatient with the botanist who refuses to accept such forms as true varieties or species as much entitled to recognition as those whose origin we do not happen to know.—CHARLES E. BESSEY.

Prillieux's Diseases of Plants.[2]—Among recent contributions to botanical literature is the first volume of a work on the diseases of agricultural plants including forest and fruit trees by Ed. Prillieux, Professor in the ("Institut National Agronomique," Paris). The work is the outcome of the author's twenty years study and teaching of Economic Vegetable Pathology.

In the introduction the change in the methods of viewing plant diseases is referred to. Instead of trying to trace an anology between human pathology and phytopathology, plant diseases came to be regarded as due to changes of normal physiological functions produced either by unfavorable conditions or by the action of parasitic organisms penetrating the tissues. The placing of phytopathology on a more rational basis is attributed to De Candolle.[3] In this connection Unger[4] might well have been cited.

The author next speaks of the aims and purposes of the work. He says: "If I am able to render the study interesting and intelligible to agriculturists and to all persons living in the country who have received some general knowledge of the structure of plants, I shall have obtained the end I have in view."

In speaking of the difficulties of studying minute parasitic plants he adds: "It seems to be established that such researches present too many difficulties to be carried on by any one who wishes. My greatest desire is to dissipate this belief and to facilitate the beginnings of observers who, living in the country, are able to test on cultivated plants the facts already observed and described, and to examine the parasites in quantity in all their stages of development. If they acquire a taste for these researches they may be able in their turn to add many new facts to science." We believe the many acute investigators who after thorough equipment have spent years in trying to solve some of the problems presented by plant diseases will not think us pessimistic if we venture to predict that the author's hopes regarding the contributions to the life histories of parasitic fungi which he expects from the novice will not be realized. If, however, he succeeds in getting the intelligent farmers to observe carefully the parasitic plants which destroy their crops, and to study and become familiar with the facts that have already been established by investigators he will have rendered an incalculable service. He next refers to the diverse forms and various stages in the life histories of many disease-producing parasites and the necessity of knowing all the facts connected with the conditions of their propagation and growth, and the importance of this knowledge as a basis in devising means of preventing or combatting them. It seems to us he might well have urged in addition the need of a comprehensive knowledge of the complex physiological activities of plants under normal conditions, as this must be the basis for an understanding of abnormal or pathological conditions, and must precede any rational treatment of such conditions.

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[2] Prillieux, Ed. *Maladies des Plantes Agricoles et des Arbres fruitiers et Forestiers causées par des parasites végétaux.* Home Premier, Paris, 1895.

[3] De Candolle, Aug.-Pyr. *Physiologie Végétale.* Paris, 1832.

[4] Unger, Franz. *Die Exantheme der Pflanzen.* Wien, 1833.

The remainder of the introduction is devoted to detailed directions for the use of the microscope. These directions are intended for beginners, and cover the simple manipulations of the instrument as used in the elementary study of plant histology.

The various parasites of which the volume treats are arranged in systematic order. The first part treats of "Cryptogamic Parasites other than Fungi." These are discussed in two chapters, one on Bacteria and one on Myxomycetes. The second part treats of "Parasitic Fungi," to which five chapters are devoted in the following order: Phycomycetes, Ustilagineæ, Uradineæ, Basidiomycetes and Ascomycetes. The style is rather concise and exact, though not so technical as to make the work forbidding or unintelligible to the non-scientific reader. The numerous figures, though in many cases crude, give a fair idea of the general characters of the object represented. It would seem that in a work intended for the use of agriculturists and horticulturists more attention might profitably have been given to the treatment of the diseases discussed. There can be no doubt, however, of the usefulness of the work, and if the class for whom it is especially intended can be prevailed upon to use it, it will assist greatly in popularizing and advancing a branch of botany which is at present in its infancy, but which is destined to great growth in the near future.

C. L. SHEAR.

Campbell's Mosses and Ferns.[5]—This book has appeared at a most opportune time in the history of botanical science, if, indeed, a long-wished for book can ever fail to be opportune. The Archegoniatæ have long been most fruitful objects of research, and the bearing of the results of such investigations upon the terminations and the beginnings of phylogenetic lines has been of absorbing interest. It was to be expected that such a field would attract the attention of many of the best botanists. So true is this, that the literature of botany for the past fifteen years has abounded in articles upon the morphology and the embryology of the Archegoniatæ. The activity of specialists along these lines has been so great that the general student has long since been compelled to relinquish the task of keeping himself accurately informed of the most recent investigations and theories. The publication of these results in numerous diverse periodicals rendered all the more imperative the demand for their collation and co-ordination. Above all, it was desirable that these collected data should come to us, not as the compilation of some superficial student of the subject, perhaps, but as a judicious and discriminating compendium based upon no inconsiderable amount of original work.

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[5] *The Structure and Development of the Mosses and Ferns* (Archegoniatæ), by Douglas Houghton Campbell, Ph, D., Professor of Botany in the Leland Stanford Junior University. Macmillan and Company, London and New York, 544 pp., 8vo

To the making of a book for American students, no one, probably, could have brought out a longer experience or a greater knowledge of the subject than the author of the present volume. The collection and arrangement of the scattered data of numerous texts and their presentation, together with the extensive results of original research, has been done in a masterful manner. The information gained by the author's own investigations have enabled him to construct an admirable ground plan into which he has woven the results of others in a most skillfully relevant fashion. Though dealing with a subject not a little complicated, the general scheme of the text is particularly fortunate, and the subject matter itself much more than ordinarily perspicuous.

A critical compilation entails the discussion of numerous antagonistic views and theories, and renders necessary a discriminating treatment of them. The author has here had no easy task and merits especial congratulation upon the successful manner in which he has acquitted himself. It would have been no more than expected if he had permitted himself to incline rather strongly toward his own views upon mooted questions. Yet such is not the case. In all instances, the arguments on both sides have been presented in the fullest manner and, in some cases, in a spirit of fairness, he has conceded, perhaps, more than necessary. The bringing together of such a mass of facts and theories has given the author a rare opportunity to deduce the tendencies which they suggest, and to critically weigh the contradictory opinions to which they have given rise. This has been thoroughly done, and the book, besides standing as a most able symposium of the present knowledge concerning the Archegoniatæ, will be of almost inestimable value for its effectual relegation of worn out ideas, and its lucid elaboration of those which are to direct future thought in these lines.

The text treats consecutively of the various orders and families of Bryophyta and Pteridophyta, dealing exhaustively with their organogeny and morphology, and discussing in a concise manner their classification and general affinities. The peculiar thoroughness and completion of the work are among its most pleasing features. From its comprehensiveness, it must be primarily a reference book, and the subject matter has been so subdivided and arranged as to greatly facilitate this purpose.

The typography of the book is good, perhaps rather above than below that which should be regarded as standard for any scientific work, in order that it may not receive unfavorable mention. Many of the figures unfortunately, show the effects of haste, whether upon the part of the artist or of draughtsman is not certain. It is to be regretted that the illustrations, which so often make a poor book, has here been permitted to mar so good a one.

I shall not place an incubus upon the book by calling it "epoch-making;" such can never be truthfully said of any scientific work. It does stand, however, as a most welcome and effective milestone, not merely for the general student of botany, but for the specialist as well. Not only will it remain for a long time a much thumbed summary, but it must be regarded as indicating at least the most immediate lines of future research among the Archegoniatæ.

FREDERIC E. CLEMENTS.

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General Notes.

PETROGRAPHY.[1]

Petrography of the Viterbo Region, Italy.—Washington[2] continues his description of the young volcanic rocks of Italy in an article dealing with the lavas of the interesting Monti Cimini, Monte Venere and Monti Vico. The principal rocks of the district are vulsinite, composed of phenocrysts of orthoclase, plagioclase, diopside and biotite in a trachytic groundmass consisting of diopside, magnetite and the feldspars; ciminite composed of small olivine, diopside, plagioclase, and sanidine phenocrysts in an andesitic felt of diopside needles, magnetite grains and feldspar laths—both orthoclase and plagioclase; peperino—a trachy andestic tuff, and a series of leucite rocks belonging with the leucite phonolites. The phonolites from Monte Venere are characterized by the presence of phenocrysts of biotite. Analyses of the three principal types are given as follows:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2	
Vulsinite	57.32	19.85	2.21	2.35	1.60	3.82	3.22	9.15	.57		=100.09
Ciminite	55.44	18.60	2.09	4.48	4.75	6.76	1.79	6.63	.25	.16	=100.75
Leucite phonolite	55.21	19.81	2.69	2.86	1.68	4.61	3.13	8.45	.99.	tr	= 99.43

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Journal of Geology, IV, p. 826.

Missourite, a New Leucite Rock.—The body of rock constituting the core of one of the volcanic centres of the Highwood Mountains, Montana, is a new type of leucite rock named Missourite by Weed and Pirsson.[3] The rock is in the form of a stock intrusive in Cretaceous shale. It varies in character in different places, but is of the same general nature in all. The coarsest grained variety is a dark gray granular rock composed of grains of fresh olivine, of pale green augite, of brownish-yellow biotite, apatite and iron oxides embedded in perfectly clear leucite in formless masses. The composition of the mineral is as follows:

SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	K_2O	Na_2O	H_2O	Total
54.46	22.24	.68	tr	.10	18.86	.70	2.29	= 99.33

A slight zeolitization has occurred in some of the leucite, the new products being analcite and a new potash zeolite analogous to natrolite. An analysis of the rock yielded:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2	P_2O_5	BaO	SrO	SO_3	Cl	Total
46.06	10.01	3.17	5.61	14.74	10.55	1.31	5.14	1.44	.73	.21	.32	.20	.05	.03	= 99.57

This is very close to the composition of absarokite.[4] Since the structure of the missourite is granitic, the author classifies it as the plutonic equivalent of the leucite basalts.

The Crystalline Schists of the Spessart.—According to Klemm[5] the crystalline rocks of the Spessart, Germany, comprise granites and schists of unknown age, with which are associated basic intrusive and effusive rocks and their tuffs. The schists occur on the periphery of a great granite mass, dykes from which have intruded them. Among the foliated rocks are quartz-schists, mica-schists, staurolite-schists, calc-silicate hornfels, limestone, amphibolites and metamorphosed sandstones and graywackes. The biotite, staurolite and other similar constituents exhibit no evidences of the action of pressure upon them, although the rocks in which they occur are highly schistose. This fact leads the author to conclude that the foliation of the rocks was imposed upon them when in a plastic state and not after they had become rigid. The amphibolites are thought to be metamorphosed tuffs. The granite is a biotitic variety with a foliation produced by pressure, but in this case as in the case of the schists, the foliation was produced before the rock finally solidified. In the character of its intrusion the granite is lacco-

[3] Amer. Jour. Sci., Vol. II, 1896, p. 315.

[4] Cf. AMERICAN NATURALIST, p. 299.

[5] Zeits. deutsch. geol. Geo., XLVII, p. 581.

litic. After discussing the nature of the schists and gneisses of this region the author concludes his paper with the statement that the term gneiss should be used in a geological sense only when the origin of the rock designated by it is unknown. He further surmises that many gneiss areas will, upon close study, be found to be underlain by granites and various schists whose nature can be learned.

Instruments.—Leiss[6] describes a number of new instruments for the use of petrographers. They are made under the direction of Fuess of Berlin. The first instrument is a microscope with nicols so arranged as to be capable of revolution independent of the stage. The stand is constructed for the attachment of the ordinary accessories. The three models at present on the market are known as VII, VIIa, VIII. The second instrument is a simplified form of Federow's universal stage, admitting of the revolution of an object about two axes while under the microscopic objective. The third is the apparatus planned by Klein to aid in the examination of thin sections immersed in liquids. The other instruments described are a compensator-ocular, invented by J. Amann, a mica-wedge after the pattern proposed by Federow, a vertical illuminator for use with opaque objects, a very simple microscope camera made to fit over the ocular of an ordinary microscope and an achromatic condenser for use with the same.

Diller[8] describes an improved form of Smeeth's separating tube for the separation of rock powders by means of heavy solutions. The new tube possesses several advantages over the Harada and the Brögger tubes.

Petrographical Notes.—The reciprocal relations existing between hornblende and augite in plutonic and volcanic rocks is explained by Becke[9] as due to the fact that hornblende contains a small percentage of constitutional water in its molecule, and that it can therefore be formed only under certain conditions of pressure and temperature when water is present in a magma. When the conditions of pressure and temperature are not right augite forms in place of hornblende. A figure showing curves exhibiting the possibilities of formation of the two minerals explains the author's views.

A massive holocrystalline rock composed of biotite, cyanite and cordierite, with apatite and rutile as accessories, was discovered by Mc

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[7] Neues Jahrb. f. Min. B.B. X, 1896, p. 412.

[8] Science, June 12. 1896, p.

[9] Sitzb. deutsch. naturw.-med. Ver. f. Böhmen. Lotos, 1896, No. 5.

Mahon[10] as a bowlder in the bed of the Satlej River near Wangtu in the N. W. Himalayas. It is regarded as a product of contact action. Its original form is thought to have been diabasic or basaltic.

In the pre-Cretaceous, Cretaceous and Eocene beds of northwestern Oregon, Diller[11] finds glaucophane schists, sandstones, limestones, basalts, tuffs and shales.

The granophyres of Strath, Skye, according to Harker[12] are filled with gabbro inclusions where they intrude a great mass of volcanic agglomerate. They are denser and darker than the normal granophyres lying north of them, in which no basic inclusions are known. The gabbro debris in the granophyres is more or less dissolved, those fragments that have most nearly disappeared being represented by isolated grains of augite, hypersthene, altered olivine, magnetite and occasionally plagioclase. The pyroxenes have suffered greater or less change into hornblende and the olivine into pilitic amphibole. The new rock formed differs from the normal granophyre in its structure, in that it appears to contain nests of secondary minerals. Other fragments besides gabbro were also noticed in the same rock.

In the course of an article on the mineral deposits of the Central Alps, Weinschenk[13] describes the granite, gneiss, aplite, lamprophyre, mica-schists, quartzite, amphibolite, serpentine and other rocks of the Hohen Tanern.

BOTANY.[1]

The Metric System in Botany.—The recent appearance of two very important works on North American botany, viz., "Gray's Synoptical Fora of North America, Vol. I, part I" and "Britton and Brown's Illustrated Flora of the Northeastern United States and Canada, Vol. I," in which the English units of measurement are used throughout, suggests the necessity of some missionary work among American botanists. Can it be possible that the botanists of this country are the most conservative of our scientific men? We take part from time to time in the action of the American Association for the Advancement of Science, in which in vigorous and logical sentences we express our admiration for the metric system and our conviction that the United States Congress is derelict toward this important matter. We urge Congress to make the use of this system compulsory, and yet we go on calmly writing books in which we use the most antiquated of measuring units. Not content with using feet and inches, we express fractions of inches in lines! We vote enthusiastically that mechanics, surveyors, farmers, statisticians and schoolmasters shall use the metric system exclusively, and yet we, the botanists, who of course are "the salt of the earth" are slow in doing what we so urgently recommend others to do. The writer hereof must plead guilty to his full share of blame in this matter in the past, but he wishes to assure his botanical friends that he does not intend to inflict a long suffering public with any work whose use will *compel* a retention of the old units, as in the case of the books referred to above. Nor are these the only books which offend in this important matter; they are singled out because of their great excellence in other respects, and also because such an anachronism was not to be expected in them. Following their lead, however, we may look for many little books with English units; thus it happens that the very books which should familiarize the people with the metric system, the semi-popular and popular books, serve to perpetuate an obsolescent, and what we say we hope will soon be an obsolete system.

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[10] Min. Magazine, XI, p. 141.

[11] 17th Ann. Rept. U. S. Geol. Survey, Pt. 1, p. 14–16.

[12] Quart. Jour. Geol. Soc., May, 1896, p. 320.

[13] Zeitschr. f. Kryst., XXVI, p. 22.

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

It is not necessary to point out the commendable exceptions to the rule; we may, however, mention the botanical publications of the United States National Herbarium, all of whose contributions, if we mistake not, conform rigidly in this respect to the demands of modern science.

The writer would urge that every botanical writer insist upon the use of metric measurements throughout, in some cases with the English equivalents in parentheses, and that the editors of our botanical journals and other scientific journals in which botanical papers are published lead the way in requiring conformity to this rule. If our academies of science and other scientific societies also will insist upon the use of metric units, the present humiliating condition will rapidly disappear.

CHARLES E. BESSEY.

Eaton and Faxon's North American Sphagna.—A short time ago a most important distribution of Peat mosses (*Sphagnaceæ*) was made by Mr. George F. Eaton. In 1893, Professor D. C. Eaton and Edwin Faxon announced the intended preparation of a set of dried specimens of all the North American species. Since that time the work has gone forward, retarded greatly by the death of Professor Eaton in 1895, whose son then undertook to bring it to completion. It is now issued under the title "Sphagna Boreali-Americana Exsiccata," and includes 172 numbers representing 39 species, distributed as follows:

I. ACUTIFOLIA.—*S. girgensohnii* Russ., *S. fimbriatum* Wils., *S. russowii* Warnst., *S. warnstorffi* Russ., *S. tenellum* (Schimp) Warnst. *S. fuscum* (Schimp) Klinggr., *S. quinquefarium* (Braithw.) Warnst., *S. acutifolium* (Ehrh., e. p.) Russ. and Warnst., *S. subnitens* Russ. and Warnst., *S. tenerum* (Aust.) Warnst., *S. molle* Sulliv. (62 specimens, representing many varieties).

II. SQUARROSA.—*S. teres* Angstr., *S. squamosum* Pers. (10 specimens and several varieties).

III. POLYCLADA.—*S. wulfianum* Girg. (3 specimens including two varieties).

IV. CUSPIDATA.—*S. macrophyllum* Bernh., *S. floridanum* (Aust.) Card., *S. lindbergii* Schimp., *S. riparium* Angstr., *S. cuspidatum* (Ehrh.) Russ. and Warnst., *S. dusenii* (C. Jens) Russ. and Warnst., *S. recurvum* (Beauv.) Russ. and Warnst., *S. fitzgeraldi* Renauld, *S. molluscum* Bruch. (39 specimens, including many varieties).

V. RIGIDA.—*S. compactum* DC., *S. garberi* Lesq. and James. (8 specimens, including several varieties).

VI. SUBSECUNDA.—*S. pylaesii* Brid., *S. obesum* Wils., *S. subsecundum* Nees, *S. platyphyllun* Warnst., *S. contortum* Schultz, *S. rufescens* Bryol. Germ., *S. orlandense* Warnst., *S. microcarpum* Warnst. (26 specimens, including many varieties).

VII. CYMBIFOLIA.—*S. portoricense* Hampe, *S. imbricatum* (Hornsch.) Russ., *S. cymbifoliam* Ehrh., *S. papillosum* Lindb., *S. medium* Limpr., *S. ludovicianum* (Ren. and Card.) Warnst. (24 specimens, including many varieties).

A personal examination of this set shows it to be in every way satisfactory, the specimens being ample and prepared with exquisite neatness.—CHARLES E. BESSEY.

The Cell Nucleus.—The latest contribution to our knowledge of the plant cell nucleus is from the hands of Dr. Zimmermann of the University of Berlin. His "*Morphologie und Physiologie des pflanzlichen Zellkernes*" is destined to be one of the most useful of books, for in it he has brought together what has been made out as to the nucleus both structurally and physiologically, for all groups of plants. In the first part of his book he takes up methods, chemistry of the nucleus, histology of the nucleus, nuclear division (karyokinetic and direct division), physiology of the nucleus, etc. In the second part the subject is taken up from the systematic standpoint, the structure and division of the nucleus being discussed for each group of plants, e. g., Angiosperms, Gymnosperms, Pteridophytes, Bryophytes, Fungi, Algæ and Schizophytes. The author has summarized the results of the investigations, and apparently given the essential facts. In all cases he makes a direct citation of the particular paper to which he refers, thus enabling the student to verify the statements made by the author. It must not be supposed, however, that the work is a mere compilation; on the contrary the author has wrought into it a great deal of his own matter, so the book is full of fresh material. It will at once find a place in every laboratory, and we hope will be made still more useful by a good English translation.—CHARLES E. BESSEY.

Another Australian Curiosity.—Some time since we reviewed an article on a strange Australian fungus which appeared to be a peculiar edible sclerotium. A recent paper[2] describes what the authors call "a stone-making fungus" for which a new genus is erected. This genus appears to us, however, of doubtful validity, and illustrates a tendency to the multiplication of genera founded upon slight and unimportant characters, which is being carried to the extreme by many of our systematic botanists and which it seems to us should be condemned. *Laccocephalum* is said to differ from *Polyporus* "in being hard and woody from the first, in the peculiarly pitted pileus and in the character of the spores." The most striking peculiarity to the superficial observer, however, is a large stone like nodule at the base of the stipe. This has a diameter equal to or exceeding that of the pileus, and is apparently composed of sand agglutinated and held together by the mycelium into a mass resembling a concretion of ferruginous sandstone.

In the specific description there are apparently some typographical errors, as the spores are said to be "44–50 inches in diameter" (meaning μ probably) with spines "3 inches long" (μ ?). The paper is accompanied by a good lithographic plate giving three views of one of the plants.—C. L. SHEAR.

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[2] D. McAlpine and J. G. O. Tepper: A New Australian Stone-making Fungus (*Laccocephalum basilapiloides*), Proc. Roy. Soc. Victoria, 1894, Art. XIV.

ZOOLOGY.

Amœba coli not Pathogenic.—This *amœba* has been met with by Sig. O. G. V. Casagrandi and Sig. P. Barbagallo-Rapissiardi[1] in cases of typhoid diarrhœa, simple intestinal catarrh, and in spasmodic dysentery, as well as in healthy persons, and the conclusions drawn were that it is not pathogenic but is a very useful guest, destroying the other organisms living in the intestine. Experiments with cats show that diarrhœa does not develop unless the intestinal canal is already in a catarrhal condition. *Amœba coli* will develop in them, but only because the dysenteric material injected sets up at the same time the condition necessary for development.

Bipalium kewense.—Mr. Woodworth's notes induce me to place on record the probable occurrence of this phanarian at Kingston, Jamaica. Some years ago, when resident there, I had brought to me an example which accorded perfectly with my recollection of the creature, which I had formerly seen at Kew. The longitudinal markings were distinct. While I have no serious doubt of the identity, I was ill at the time of receiving the specimen, and failed to give it the attention it deserved.—T. D. A. Cockerell, Mesilla, N. M.

Egg-Laying in Sagitta.[2]—In the case of *Sagitta hispida* Mr. F. S. Conant finds that the process of egg-laying takes place in the morning, in this respect differing widely from *Sagitta bipunctata*, which deposits its eggs at about sunset, as observed by Fol, and agreeing with *Sagitta hexaptra* as noted by Grassi. Variations in temperature affect the time somewhat, cold retarding the process.

The ova pass through the wall of the germinal epithelium into the oviduct, apparently through interspaces in the wall of this, undergoing by the way a progressive series of changes in shape. In the oviduct the ova remain from 20–30 minutes, their gelatinous envelope thickening meanwhile. Contractions of the ovary result in pushing the eggs backward towards the external opening, and when the pressure has become sufficient the plug closing this is forced out and the eggs are extruded in two linear rows (one on either side the animal) of only a few or as many as 60–70 eggs each. This does not differ essentially from the act of laying, as seen and described by Boreri in *S. bipunctata,* the sausage-form that these eggs pass through being given them in the latter case by pressure while still in the ovary.

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[1] Catania, 1895. See J. R. M. S., p. 429.

[2] Ann. Mag. Nat. Hist., XVIII, pp. 201–214. Johns Hopkins University Circulars, xv. (1896) p. 82–4.

Mr. Conant was unable to determine definitely the location where fertilization takes place, but supports Hertwig in affirming contra Grassi that no spermatozoa are found in the ovary. What little evidence he has indicates that fertilization takes place while the ova are in the duct between the exterior opening and the opening of the duct of the receptaculum seminis. Self-fertilization seems impossible.

The eggs when laid become attached to the sides of the dish by a gelatinous substance that facilitates handling, but collects dirt. In warm weather development to hatching takes place in about 36 hours, and then the animals are miniatures of the adult form, and all are as ready to devour their comrades as are the mature animals.—F. C. KENYON.

The Chætognaths of American Waters.—In his paper just cited Mr. Conant gives nine species as the total number known to occur in American waters. Among them he enumerates five new species added by himself. One of these has caused him to make some very pertinent remarks concerning the divisions of the old genus of *Sagitta* into *Sagitta, Krohnia,* and *Spadella.* He agrees with Béraneck's criticism of the systems proposed by Langerhans, Hertwig, and Grassi, and like this author concludes, though under protest, to follow with Strodtmann the arrangement proposed by Langerhans. It would have been much better, however, had he obeyed the impulse that his new species produced, and described all nine as species of *Sagitta,* instead of sandwiching species of *Krohnia* and *Spadella* in irrregularly between undoubted species of *Sagitta.* Or he might at least have placed the terms *Krohnia* and *Spadella* in parenthesis.

But, notwithstanding the doubt that arises as to which of the older arrangements to follow in placing Mr. Conant's new species, it should be remembered that after all any system of classification is very largely for convenience, and that in the present state of our knowledge, not only of this particular group of animals but of the fundamental laws governing the evolution of one form from another, any system proposing to show genetic relationship is at least only tentative, and often weakly so at that. In this particular case whether we should regard the number of fins with Hertwig, the so-called teeth, or with Strodtmann and Béraneck, the sum of the characters as the determining features is still a doubtful matter. Judged from the standpoint of convenience the arrangement given by Hertwig seems the best, and for that reason, if not for the sake of showing true genetic relationships, the synopsis below is given.

A. With caudal and with one pair of lateral fins, *Spadella.*
  a. Anterior teeth wanting.
    Posterior teeth many. Seizing-hooks 8–9. Length 35 mm. (According to Möbius). Taken off Martha's Vineyard, North Atlantic, *S.* (*Krohnia*) *hamata* (Möb).
  b. Anterior teeth present.
    1. Seizing-hooks 6. Anterior teeth 3–5; posterior teeth 5–7. Length 52 mm. North Atlantic. Lat 42°, 28′; long. W. 50°, 55′, 30″, *S. maxima* Con.
    2. Seizing-hooks 10. Anterior teeth 8; posterior teeth 18. A broad bilateral outgrowth of the epidermis distinguishes this from all others. Bahamas (Binnini), Messina, Naples, Madeira and Canary Islands. Length 10 mm., *S. draco* (Krohn) Langer

B. With caudal and with two pairs of lateral fins, *Sagitta.*
  a. Posterior teeth wanting. Second pair of fins split posteriorly into 4 villus-like processes. Seizing-hooks 8. Anterior teeth 4–6; corona ciliata forming a peculiar triangle on head and neck. Tail equal half total length. Bahamas (Binnini). Length 4 mm., *S. schizoptera* Con.
  b. Posterior teeth present. Fins entire.
    1. Seizing-hooks 7–8.
      a. Anterior teeth 3–4; posterior teeth 4–7. 2 external intestinal diverticula. Length 24–34 mm. Martha's Vineyard, Atlantic and Pacific Oceans, *S. hexaptera* (Orb.).
      b. Anterior teeth 4–5; posterior teeth 7–10. No diverticula. Length 5.25 mm. Jamaica, *S. tenuis* Con.
    2. Seizing-hooks 8–9.
      a. Anterior teeth 4–5; posterior teeth 8–15. Caudal segment one-third total length. Length 7–11 mm. Jamaica, Bahamas, N. Carolina, *S. hispida* Con.
      b. Anterior teeth 7–8; posterior teeth 10–12. Corona ciliata confined to head. Length 13–18 mm. Bahamas, *S. flaccida* Con.
    4. Seizing-hooks 9–12.
      Anterior teeth 5–7; posterior teeth 12–15. With both external and internal intestinal diverticula. Length 16–33 mm. Vineyard Sound, Gay head on English coast, *S. elegans* (Ver.).

—F. C. Kenyon.

New Central American Diplopods.[3]—Among a lot of chilopods and diplopods that Dr. Filippo Silvestri describes as collected by Dr. Festa at Guayra, Darien and Cuenca he describes the new species *Archispirostreptus guayrensis*, *Plusioporus festæ*, *Rhinocricus diversicauda*, *Oxypge varicolor*, *Ortomorpha festæ*, *Aulocodesmus angustalus.*

The genera *Oxypyge* and *Alocodesmus* are new. The former approximates very closely to *Rhinocricus*, but differs from that in having the anal valves produced into long straight spines. The latter approaches Pocock's *Odontopeltis*, but differs in the position of the pores, in the granular surface and the dorsal sulcus.—F. C. KENYON.

The development of the Wing-scales and their pigment in the Lepidoptera.[4]—The scales of the wings of Lepidoptera are shown by Mr. A. G. Mayer to be developed from modified hypodermis cells like the hairs of other arthropods. The pigment comes from the so-called pupal blood by a series of chemical changes. The colors of the adults are not formed at once, but all pass through a series, the first of which is a dull ochre-yellow. He succeeded by chemical means in making pigments from the pupal-blood or hæmolymph that were similar in color to the colors of the adult insects. These pigments react to chemical agents similarly to the pigments of the insects.

Dull ochre-yellows and drabs such as one finds among the nocturnal Lepidoptera are the oldest, the bright yellows, reds, and greens of the diurnal forms are derived by a complicated chemical process brought about in the parts most exposed to the light.—F. C. KENYON.

Rapid Growth of Apus.—From Spencer and Hall's[5] account of the crustacea of central Australia we learn that not more than two weeks, and probably only a few days after the fall of rain, specimens of *Apus* were found measuring 2½ to 3 inches in length. When it is remembered that the eggs of *Apus* must pass through a stage of drought before they will develop, this enormously rapid growth is truly remarkable. And the evidence of it is conclusive, if it be impossible for the mature or nearly mature form to pass through the period of drought, which certain forms, e. g., *Astacopsis* and *Telphusa* are known to be able to do.—F. C. K.

Steindachneria.—In 1888 the name *Steindachneria* was twice used to designate new genera of fishes.

Goode and Bean in Agassiz, Three Cruises of the Blake II, p. 26 (April, 1888) used the name for a macrurid taken by the Albatross off the delta of the Mississippi River. The fish was mentioned in the following language: * * * *Steindachneria*, a macruroid with a high differentiated first anal fin, has been obtained by the "Albatross" in 68 fathoms." No specific name and no figures were published.

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[3] Bull. Mus. Zool. Anat. Comp. Univer. Torino., XI.

[4] Bull. Mus. Comp. Zool., XXIX, 209–36, 7 Pls.

[5] Horn Scientific Exp., 1896, pt. II. J. R. M. S., p. 410.

We used *Steindachneria* for a silurid genus inhabiting the rivers of southeastern Brazil in a paper issued July 18, 1888 (Proc. Cal. Acad. Sci. 2d. Ser., Vol. 17). The name was defined and referred to a described species. Mr. S. Garman called our attention to the previous use of *Steindachneria* by Goode and Bean. An examination of Goode and Bean's note showed that their name was a nomen nudum, neither described nor referred to any published species. On learning this we wrote Dr. Goode an apologetic note calling his attention to these facts and received the following in reply. "*Steindachneria* has never been published, though the diagnosis of the genus has been lying in MS. for nearly two years. So we will change the name. It is not of the least consequence." This was under date of Oct. 1, 1888. This intention to change the name was never carried out and in "Oceanic Ichthyology" (p. 419) which has just been received, *Steindachneria* is still retained for the macrurid and reference made to "Three Cruises of the Blake." The name *Steindachneria* being preoccupied for the cat fishes I would suggest the name *Steindachnerella* for the macrurid to carry out the idea of honoring the Custos of the Imperial Zoological Museum of Vienna.—C. H. EIGENMANN.

Mutilations of the Oregon Redfish.—The sores, frayed-out fins, and other mutilations which have been noticed upon the Chinook salmon and redfish by every one who has ever seen these fishes upon their spawning-grounds have been regarded by all as being due chiefly, if not wholly, to the injuries incident to the long journey from the sea. Coming so these Idaho lakes from the sea requires a journey of more than 1000 miles, and it is, in large part, through swift and turbulent waters and up dangerous rapids, cascades, and waterfalls against whose ragged and jagged rocky walls and bed the fish would often be thrown by the seething currents. That they could make this long and perilous journey unscathed could scarcely be believed.

In the shorter coastal streams of Oregon, Washington, British Columbia, and northward, the same mutilations have been observed and have usually, without sufficient reason, been attributed to the same cause. Until now it has, therefore, generally been held that the injuries are received by the fish while en route to the spawning-grounds. Our continuous series of observations at Alturas Lake during the entire period of the breeding season shows, however, that this is not the true explanation. Among the hundreds of redfish that we examined as they came up into Alturas Inlet from the lake not one possessed any sores, or had the fins frayed out in the least; every one was perfect in every way, so far as mutilations were concerned. Not only were all of those caught on the gill nets as they came up from the lake free from sores, but no sores were seen on any of the fish in the creek until some time after the spawning had begun. The first fish were seen July 24, but not until August 10 were any mutilated ones observed, and then only 3 out of 84 examined showed any considerable mutilations.

In marked contrast with this perfect condition of the fish as they arrive upon their spawning ground is that observed toward the close of the spawning season when scarcely a fish can be found whose fins are not badly frayed and upon whose body are not one or more large sores.

The manner in which the mutilations are really received was readily determined by watching the fish while spawning. The spawning-beds are usually in very shallow water, often only a few inches deep. These beds are of fine granite gravel and sand. There is more or less definite pairing off of the fishes, and each pair usually does all its spawning on a certain area, which may be called the nest. The gravel and sand of this area are moved about and piled up somewhat in heaps or rows as the fish scoop out shallow depressions in the bed; this scooping or moving of the gravel is done as the fish swims upstream over the bed with a rapid quivering motion of the body; during this act the body is always inclined to one side and the gravel is chiefly pushed in the other direction; after swimming across the nest in this way, the fish circles around downstream and returns to the bed to repeat the process again and again, keeping it up for several days. During all this time the male follows closely behind the female, sometimes quivering and plowing through the sand and gravel in the same way and thus receiving mutilations of the same character. Often the back of the fish is turned against the gravel and becomes worn. On each spawning-bed are usually several supernumerary males, and among them and the paired males there is much chasing about and some fighting which results in still further mutilations. It may, therefore, be positively stated that the sores and mutilations seen on the redfish at the Idaho spawning-grounds are practically all received after the spawning season begins (B. W. Everman in U. S. Fish Commission Bull. for 1896, Art. 2.)

On the Occurrence of the genus Reithrodontomys in Virginia.—On December 6, 1896, I trapped an adult male Harvest

Mouse, *Reithrodontomys lecontii* (Audubon and Bachman) at Fort Myer, Virginia. The trap was set under a fence between cultivated fields and a strip of woodland. I believe this is the most northern point on the Atlantic coast at which a specimen of this genus has been taken; and I know of no published record of its occurrence in the State of Virginia or in the District of Columbia. This specimen is number 83,298 of the United States National Museum collection.—LOUIS ZEREGA MEARNS.

Inheritance of the Monodactyly in the Pig.—The monodactyly, observed in the pig by Aristotle, has persisted to the present time. M. Vasilesen, Professor of Zoology in the Veterinary School at Bucharest, has had the progeny of a male monodactyle pig under observation for a number of years. He notes that of 54 descendants 39 are monodactyle and 13 bidactyle. M. Vasilesen concludes from these observations that the monodactyly of the pig is a hereditary tetralogical phenomenon, susceptible of being transmitted from one generation to another, reproducing itself indefinitely. (Revue Scientif., Oct., 1896.)

Preliminary Description of the Newfoundland Marten.—The marten has long been known as an inhabitant of the Island of Newfoundland, being given by Henry Reeks in 1870 (under the name *Mustela americana*) in his list of the Mammals of Newfoundland.[6]

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[6] The Zoologist (London), 2d Series No. 54, pp. 2033-2049, March, 1870; No. 67, April, 1871, pp. 2540–2553. Notes on the Zoology of Newfoundland. By Henry Reeks.

No. 54, March, 1870, p. 2037, reads as follows:

"*American Sable*, *Mustela americana*, *Turton*; *Pine Marten*; *Marten Cat* (Newfoundland).—Still common in various parts of the island, but from the increasing, or, at any rate, present value of the fur is annually becoming scarcer. It is a bold rapacious animal, and in its habits remind one much of the common polecat (*M. putorius*). One of the specimens I obtained entered the house of a settler and carried off a dead duck (*Anas obscurus*), but was subsequently shot in a tree near the spot, in fact, while returning for a second duck, having probably hid the other. Marten cats are easily caught by iron traps placed in "cat-houses," or in "dead-falls." Without attempting to settle, or even discuss, the vexed question as to the identity of this species with the European, *M. zibbellina*, I may here state that very little reliance can be placed on the colors of the Martinæ, as a very appreciable difference exists in this particular, even in specimens obtained in Newfoundland and the Labrador, the former being much lighter throughout, but especially about the head and ears. So perceptible is the distinction that a trader readily separates the Newfoundland skins from those obtained on the mainland."

Like most of the mammals of this island it is, however, very different from its mainland cousin, and as no possible connection can now exist between it and the continental form it must rank, a full species, as

MUSTELA ATRATA SP. NOV.—Type from Bay St. George Newfoundland, No. 5752 ♀ adult, coll. of E. A. and O. Bangs. Collected by Ernest Doane Sept. 29th, 1896. Total length 548, tail vertebræ 185, hind foot 89, ear from notch 43.

General Characters.—Size about that of *M. americana* (probably somewhat larger); color very different, suggesting a dark colored mink, rather than a marten; skull slightly different:

Color.—Deep chocolate, becoming black on back, head, arms, legs, rump and tail; a few white hairs scattered along back; chest and under side of neck irregularly blotched with orange; a median line of orange on belly; ears black narrowly bordered all round with dull white; a patch of yellowish-white hairs in front of opening of ear.

Cranial Characters.—Skull about the size or larger than that of *M. americana;* rostrum narrow; audital bullæ much larger and deeper than in *M. americana* and with a more marked "bottle-nose" projection; dentition rather weaker throughout, with greater spaces between premolar teeth, than that of *M. americana.*

Size of the type skull, ♀ "middle aged', adult: Basilar length 69.2; zygomatic breadth 42; mastoid breadth 34.2; breadth across roots of canine teeth 14.2; greatest length of single half of mandible 49.6.

Size.—The type ♀ adult; total length 548, tail vertebræ 185, hind foot 89, ear from notch 43. Of an adult ♀ prolotype, (No. 5751 Bangs coll.). Total length 559; tail vertebræ 185, hind foot 86, ear from notch 41.

Remarks.—The above description is based upon two beautiful skins accompanied by skulls, both "middle aged" adult females. Neither has the fur quite "prime," both being taken in September. In its full winter dress, this marten must be a superb creature.

There is a series of eleven skulls of *M. atrata* in the collection of the Museum of Comparative Zoology, at Cambridge, Mass. collected in Newfoundland in 1865 by James M. Nelson. I have examined these and find some of them to be old adults, but all are unsexed. They bear out the characters claimed for *M. atrata*—the large, peculiarly shaped audital bullæ, and the weak dentition, and would seem to indicate that *M. atrata* is a larger animal than *M. americana.*—OUTRAM BANGS.

Zoological News.—According to F. Neri,[7] who has been studying the beaks of cephalopods, these structures are composed of fibrous cuticular laminæ, which chemically are not chitinans but keratinous. The upper part is encrusted with lime.

The results of the Austrian deep sea expeditions of 1890–4 show, according to Dr. R. Sturany,[8] that the eastern portions of the Mediterranean is much poorer in deep sea shells than the western basin, and further, that the fauna is doubtless of Atlantic origin.

ENTOMOLOGY.[1]

The American Spring-tail.—This very anomalous little insect (*Lepidocyrtus americanus* Marlatt) measuring scarcely more than one-tenth of an inch, silvery gray in color, with purple or violet markings, may be frequently observed in houses. In common with the silver fish, it belongs to the order of insects known as Aptera (wingless), from the fact of their having no vestige of wings throughout life.

The simple structure of these insects, and particularly their resemblance to the larval state of winged insects, has led to the belief that they are the primitive forms of insect life. That this is true is, however, by no means certain, and they may rather be degraded or debased examples of some of the higher orders of insects. The species figured herewith is not infrequently found in dwellings in Washington, but is apparently undescribed, and, in fact, little is known of the American species. It is, however, closely allied to a European form (*L. cervicalis*), often found in cellars, and figured by Sir John Lubbock in his monograph on these insects. Another allied European species (*Seira domestica*) has been named from the fact of its being a frequenter of houses.

These insects belong to the suborder Collembola, which (following Sharp) is distinguished from the other suborder of Aptera, Thysanura, by having but five body segments instead of ten, and possessing a very peculiar ventral tube on the first segment, and commonly also a terminal spring, by means of which these creatures leap with great agility, and from which they take their common name of "spring-tails."

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[7] Atti Soc. Tasc. Sci, Nat., x (1896), J. R. M. S., p. 401.

[8] S. B. K. Akad. Wiss. Wein., 1896. J. R. M. S., p. 400.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

These insects, though very abundant, have been very little studied, and little is known of their life habits. They often multiply in extraordinary numbers, especially in moist situations, swarming on the surface of stagnant water or on wet soil. They seem to be very tolerant of cold, and we have interesting accounts of the occurrence of a species related to this one in the Arctic regions on melting snow fields and on glaciers, where they are known as "snow fleas" or "snow worms." Other interesting forms occur in caves, and in the Mammoth Cave in Kentucky they are notably abundant. In houses they may often be found on window sills, in bathrooms, and sometimes, under favorable situations, in very considerable numbers. Especially are they apt to occur where there are window plants or in small conservatories, but are not confined to these situations. Very little is known of their food habits, but they are supposed to subsist on refuse or chiefly decaying vegetable matter.

The striking peculiarities of these insects are in the remarkable ventral tube and the strong saltatorial appendage of the extremity of the body. The first arises from the forward body segment, and seems to act in this species as a sort of a retainer for the leaping organ, or spring proper. It is said to secrete a viscid fluid, which enables the insect to better adhere to smooth vertical surfaces. The so-called "catch," or retainer proper, is shown in a small projection between the hind pair of legs and the spring, and grasps the latter near the middle. The springing organ is two-jointed, the last joint being bifurcate, and its terminals inclosing the ventral tube.

These insects can not survive dryness, and, while they will not often occur in sufficient numbers to be particularly objectionable, the removal of the moist objects or surfaces on which they congregate and the maintenance of dry conditions will cause them to soon disappear.—C. L. Marlatt *in Bulletin, No. 4, U. S. Division of Entomology.*

Sphinx Caterpillar Surviving Ichneumon Attack.—Rev. T. A. Marshall records[2] an interesting case of this kind. A caterpillar of *Acherontia atropos* had been 'forced' by artificial warmth to an early development of the moth. The latter was a perfect specimen; in its abdomen was found a large Ichneumonid larva. "From the caterpillar point of view we have here only an instance of tenacity of life under trying circumstances. * * * In the normal course of things the death of the Atropos larva after its change to a chrysalis, and the production of a living ichneumon, would inevitably have taken place sometime next spring. But the development of the chrysalis having been artifically hastened, the parasite had no time to cause its death, and the exhaustion of vital juices was not sufficient to prevent the final metamorphosis. Hence the phenomenon of a half-grown parasite being found in the body of a perfect moth.

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[2] Ent. Monthly Mag. Dec., 1896.

"The eventual death of the moth from the action of the parasite is probable, but not quite certain. It would seem to depend upon two doubtful questions: (1) What is the natural duration of the life of an Atropos? and (2) Would the robust constitution of which proof has already been given, enable it to hold out till the parasite had escaped from its body? The single perforation of the cuticle necessary to permit the issue of the ichneumon might not be mortal in its effects. The fatal result in other cases is believed to depend partly upon the breaking up of the tracheal system by numerous perforations, and partly upon exhaustion of the vital forces. The moth in question would only be subject to the first of these injuries in a very mild degree; and its great bulk and strength might enable it, as heretofore, to defy the second. It seems, therefore, not unreasonable to suppose that, if left to nature, it would ultimately have recovered."

A Viviparous Ephemerid.—M. Causard records[3] the following interesting observations the Ephemerid *Chlœopsis diptera* Latr. "This species is very common in houses at the end of summer and the commencement of autumn, when these insect attach themselves to the windows or the ceilings, and there rest immovable, their two wings turned back, and applied one against the other, the posterior part of the abdomen terminated by two long filaments, turned back upon the dorsal aspect. The same insect may be observed in the same place for several days. Having captured a large number of them, I have been able to keep them for more than three weeks before they laid their eggs. I have found it impossible to fix exactly the duration of their existence, because at the time of capture I did not know how long they had emerged from the nymph state. However, that may be, there are Ephemeræ which have but little title to the name. This relatively long existence in the adult state is in accord with their processes of reproduction.

"Desiring one day to study the circulation of the blood in one of these insects, in the living state, which I supposed to be sufficiently transparent for the purpose, I took one of them and placed it between two plates of hollowed glass. The pressure of these plates caused a

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[3] Comptes Rendus, CXXIII, 705; Ann. and Mag. Nat. Hist., v, 18, p. 481.

quantity of greyish matter to exude from the abdomen of the animal; I regarded the insect as dead and my observation a failure. Nevertheless, on examination with the microscope, I observed that the extruded matter was formed of a large number of little ovoid bodies, which immediately began to move about and unroll themselves. Each of them was a little larva, which was very active and began to swim about. Were these Ephemeræ viviparous? This was the question that I at once asked myself. Then I examined the contents of a large number of individuals, and I found eggs in every stage of development; in some the segmentation was but slightly advanced, but a commencement of evolution was very distinct; in others, the extruded larvæ showed segmentation; the most advanced enclosed completely developed larvæ, but still enclosed in the transparent membrane of the egg. I have since been able to observe the females emitting their larvæ freely without any pressure, so that their viviparity is a proven fact. When the moment approaches that the insects seek the water, they allow themselves to fall into it and float on the surface, with their wings extended, up to the moment at which the larvæ are extruded. During this operation, which lasts for a very short time, the whole of the last three segments of the abdomen are lifted upwards so as to form almost a right angle with the rest of the body. The larvæ are expelled by a double orifice pierced between the seventh and the eighth abdominal rings; these two openings are only separated from one another by a very slight portion of tissue, and generally break into one another so as to become one after the deposition of the egg. There results a large slit which involves the whole of the lower half of the line of junction of these two rings. In this case the digestive tube is burst so that the nerves are detached behind the last nervous ganglion which occupies the seventh abdominal ring. These observations led me to study the female genital apparatus, which ought to be constructed with a view to the internal development of the eggs. Almost the whole of the body of the female is occupied by two sacs attached, the one to the other, along the middle line; the vertical partition which separates them is traversed by numerous tracheæ. These sacs extend over the whole abdomen, with the exception of the last two segments, and reach as far as the head, occupying in the three thoracic rings almost the whole of the space left free by the muscles of the wings and legs. Beneath them is the digestive tube, reduced to a canal with a thin and delicate wall and the nervous chain. These two sacs open on the outside, each by a distinct orifice pierced in the membrane which joins the seventh abdominal ring to the eighth, and, as already described, at the moment of the exit of the larvæ these two openings run together to form one. To what part of genital apparatus of other insects does this double incubation sac correspond? I have not yet been able to settle this point, in as much as I have only had under observation insects in which the sacs were already filled with eggs in course of development, and in which the empty and shrivelled ovaries were with difficulty visible. In spite of the relatively long duration of their life, the Chlœopses takes no more food in the adult state than the other Ephemeræ. Their mouth is only armed with a few soft and incomplete parts.

"The larvæ are elongated, very active, armed with feet terminated by a single hook. The head, roughly pentagonal in form, bears two long antennæ and five ocular spots of which one, odd, is situated between the bases of the antennæ; the four others are arranged in two pairs, of which the posterior furnishes the reticulated eyes of the adult. The mouth is provided with a masticatory apparatus, which is well formed. The abdomen is formed of ten segments, of which the last bears two long filaments provided with a few stiff hairs. The length of the body is 0.7 millim., not including the caudal filaments, which are at least as long as the body. The cephalo thorax and the anterior part of the abdomen contain at birth brilliant globules, which disappear in a day or two. During the first period of their existenee the larvæ have neither tracheæ nor tracheal branchiæ. Six days after their birth the larvæ undergo a first change; their appearance changes but little, but on each of the 2nd, 3rd, 4th, 5th and 6th abdominal rings there appears a pair of short prominences, each as much developed as the others, the rudiments of the future tracheo-branchiæ. Three days later there is another change; the five prominences just mentioned become elongated, and a pair of them appear on the first abdominal ring, the tracheæ also become visible. After the third change, the five pairs of tracheo-branchiæ are well formed and receive the tracheæ. Those of the first ring do not develop completely until the fourth change, and, finally, those of the seventh abdominal ring, apparent at the third change, are not complete till after the fifth. From that time the larva possesses all its organs."

EMBRYOLOGY.[1]

The Corpus Luteum.—The fate of the Graafian follicle of the Mammal's ovary is certainly very remarkable. The well known corpus luteum that results from the rupture of the follicle is generally thought to be a growth of connective tissue, for the most part. J. Sobotta,[2] however, finds that in the mouse this structure is formed by the enlargement of the epithelial cells of the follicle, aided by growth of connective tissue. His results are obtained from the very large number of sections used in his previous study of the fertilization and cleavage of the mouse's egg (See AMERICAN NATURALIST Aug. '95) and from the thousands of specimens at his disposal he is able to write a complete history of the corpus luteum.

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[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts reviews and preliminary notes may be sent.

It is interesting to note that in three cases in which the egg was abnormally retained in follicles that had ruptured as usual when ripe the usual corpora lutea were formed, though of course the egg had not been fertilized. This and other reasons lead the author to affirm that, in the mouse, no distinction can be drawn between corpora lutea vera and corpora lutea spuria, that is to say the yellow body is just the same whether the egg is fertilized or not.

The chief results of this paper may be summarized as follows:

In the ripe Graafian follicle of the mouse the connective tissue sheath is composed of a fibrous outer part and of an inner coat of large, rounded cells; the many-layered epithelium internal to the latter shows mitotic divisions; at the centre is the usual liquid bathing the discus proligerous that envelopes the egg. Both the connective tissue and the epithelial layers are much thinned away on the side next the body-cavity where the rupture is to take place.

When the follicle bursts it happens only exceptionally that blood escapes into its central cavity. The ruptured follicle is at first just like the ripe one except for the loss of the egg, discus proligerous, and the chief part of the liquid. The cleft in its side is very quickly healed over by the union of its epithelial edges.

About an hour after the rupture of the follicle the cells of the inner connective tissue sheath begin to divide by mitosis and liquid is secreted into the central cavity. Migratory corpuscles appear in the inner connective tissue sheath.

In from five to seven hours the growth of this sheath gives rise to fine radiating partition that penetrate the epithelial layers. The inner sheath is used up in the growth of these partitions as they extend in through the epithelium to the central space; leucocytes are found all through the epithelial layers.

After forty to fifty hours the liquid accumulated in the central space has been reabsorbed and its place taken by a small, gelatinous connective tissue mass; about this the epithelial cells are subdivided by a network formed from the radiating partitions and the leucocytes; the epithelial cells in the meshes of this network are much enlarged but not increased in number, division having ceased at the time of rupture.

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[2] Archiv. f. Mik. Anat. 47, April, 1896, pp. 261–306.

The yellow body is complete in from sixty to seventy-two hours. It is then much larger than the original Graafian follicle, as the epithelial cells are swollen to ten times their former size and are intertwined with the newly formed connective tissue bearing a rich network of capillaries. Later more or less fat is deposited in the epithelial cells and the body has a slightly yellow color, but here, as in some other mammals, the name is misleading.

As far as the author's observations go the corpora lutea do not degenerate, in the mouse, but remain unchanged during the life of the animal and thus add much to the size of the ovary.

Cleavage in Ovarian Eggs.—Professor J. Janosik[3] finds in some follicles that atrophy in the rabbit and guinea-pig ovarian eggs may undergo a real cleavage, though of course there has been no fertilization (as far as known). Such ovarian eggs may form small cells very like polar bodies and lying near a true spindle which is in the position of a maturation spindle. This is more common in young than in old animals.

There are cases of true cleavage with few to many nucleated cells and these cells may be of equal size or some large and some small. There are also cases of "fragmentation" where the isolated masses of protoplasm contain no visible nucleus. In these cases of ovarian cleavage the membrana pellucida disappears as it does in the normal cleavage. Such eggs later atrophy with their follicles.

PSYCHOLOGY.[1]

Annual Meeting of the American Psychological Association.—The Fifth Annual Meeting of the American Psychological Association was held at Boston and Cambridge, on December 29 and 30, 1896. The step taken a year ago of affiliating with the American Society of Naturalists proved so successful that this course has been adopted permanently by the Association. At the present meeting about 35 members were in attendance, besides a large number of visitors who came to the various sessions. The proceedings as a whole were very interesting. The number of papers offered was too great, however, for the time allotted to the sessions; as a consequence each speaker was limited to 15 minutes, involving in many cases a rather fragmentary presentation of the subject. This gave the meeting a somewhat unfinished and unsatisfactory character, for which the content of the papers was in no wise responsible.

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[3] Archiv. f. Mik. Anat., 48. Nov. 7, 1896, pps. 169–181.

[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.

The Association held two sessions for the presentation of general papers, on Tuesday and Wednesday mornings, and a special session on Wednesday afternoon for the reading of the President's Address and the transaction of business. Besides this many members attended the discussion on the Inheritance of Acquired Characteristics, before the American Society of Naturalists, where the psychologists' standpoint was represented in the discussion by Prof. James. The lecture Tuesday evening by Mr. Alexander Agassiz on Deep-Sea Soundings, and the reception afterwards at Mr. Agassiz's house, were largely attended by the psychologists, as was also the Annual Dinner of the Affiliated Societies at the Hotel Brunswick, Wednesday evening.

The session of Tuesday morning, (December 29th), was held at the Harvard Medical School in Boston, and was devoted more especially to the experimental side of psychology. The proceedings opened with a paper on the "Physiology of Sensation," by Dr. E. A. Singer, and one on the "Intensity of Sensation," by Mr. J. E. Lough. Both speakers discussed the physical bases of sensation differences. According to Dr. Singer, the data which yield quality distinctions are physiological, and depend on functional differences of the end-organs; while the intensity data, on the other hand, are physical, depending directly on the intensity of the external stimulus. Mr. Lough discussed various theories of intensity, and took the position that the intensity characteristic depends on the greater or lesser prolongation of the stimulus. The maximum intensity effect of a particular stimulus is reached only by passing through a series of neural effects which are the maxima of other lesser stimuli. With a duration less than that which is required to produce this maximum, the effect is a lessened intensity. The speaker reported a series of experiments whose results substantiated this view. Two slits of different breadths were arranged one above the other in a pendulum, so as to admit light and cast two bright images on a reflector. These two images were of the same size and objective brightness; when the pendulum swung, they appeared at the same instant, but one lasted twice as long as the other. It was found that up to a certain time of exposure the broader slit gave an effect of about double the brightness of the other. This was taken as the time required for the maximal effect in the larger slit. When the time of swing was further lengthened this difference in intensity diminished and finally disappeared. Mr. Lough drew a parallel between the intensity series and the scale of muscular sensations, though he was inclined to regard the latter as more than a mere intensity series.

Prof. G. A. Tawney reported some experiments on the effect of practice upon the tactual double point threshold, and the so-called 'Vexirfehler.' As a rule he found that any reduction of the threshold was accompanied by an increase in the number of Vexirfehler. His experiences with different subjects indicated their division into three distinct classes. In some subjects there was a large reduction of the threshold as a result of practice, with a corresponding increase of Vexirfehler; this reduction of the threshold was not confined to the regions actually practiced upon nor to their symmetrical points, but there was found to be a sympathetic reduction all over the body. In other subjects there were few Vexirfehler and only slight reductions of the threshold from practice. In others many Vexirfehler occurred from the very beginning, so that it was difficult to obtain any reliable value for the threshold. Suggestion was found to play an important rôle in every instance, and the results varied greatly according to the degree in which the subject was instructed beforehand as to the purpose of the experiment; where any suggestion was carefully avoided no real reduction of the threshold occurred; some of the subjects to whom no intimation of the nature of the problem was given, failed to get any Vexirfehler at all. The whole phenomenon of threshold reduction and Vexirfehler thus seemed to require a psychological rather than a physiological explanation.

Mr. A. L. Lewis, introduced by Prof. Witmer, read a paper on "Comparison of the Times of Simple Reactions and of Free Arm Movements in Different Classes of Persons." His subjects were white men and women, Indians and negroes, both of the latter classes being males. The instrument used was the Hipp chronoscope, which was tested before and after every series, giving constant and variable errors of only 1σ each. Reactions on sound showed the order, from the shortest time upward, to be Indians, white men, negroes, women; the first two classes were between 100σ and 110σ, the last two were between 150σ and 160σ. For visual stimuli the white men gave a reaction time somewhat shorter than the Indians; the time for free arm movement followed the latter order. In each case the time of the women was considerably longer than that of the white men and Indians.

Prof. Cattell reported upon the work in progress at the Columbia laboratory. He spoke of investigation on the nature of mental imagery. An object is named by the investigator, and the subject reports the order in which the images from different senses are recalled; a passage is read, and the nature of the resulting memory images is investigated in a similar manner. An examination of various poets shows that some, (such as Swinburne), habitually avoid certain harsh sounds, while others, (such as Browning), pay little heed to this point; the former seem better adapted for loud reading, the latter for visual perusal. Prof. Cattell reported another study on the nature, duration, etc., of after images, with special reference to the individual peculiarities of different subjects. The problems under investigation at Columbia include also one on the relation of objective rhythm to the greatest possible speed of voluntary rhythmic movements, one on color nomenclature, and one on the relation between the duration and intensity of light stimulation. According to Prof. Cattell, the results in the last case thus far were not in agreement with those reported by Mr. Lough.

Prof. Witmer read a paper on the "Organization of Practical Work in Psychology." He spoke of the beneficial results to be obtained from the correlation of psychology with medicine and teaching. Up to the present time the results of contemporary psychological investigation have not been scientifically applied, in the instruction of either normal or defective children. Prof. Witmer recommended a number of steps to be taken with a view to accomplishing this end: 1. A series of uniform psychological tests, determined at the outset and not altering constantly with changes of fashion, to be applied everywhere to school children of all grades, and to follow as far as possible the same child throughout its course. Another series, devised in the same way, to be applied similarly to the mentally defective. 2. A permanent exhibit of the results obtained from these tests, and of the methods employed in making them, which should be accessible to teachers and others interested. 3. An experimental training school for the defective classes under psychological auspices. 4. A psychological clinic and dispensary, in charge of an 'expert' with thorough medical as well as psychological training, for children who without any marked mental deficiency are nevertheless backward under the ordinary methods of teaching; children would be brought here for consultation, and after examination the proper treatment or course of training would be recommended.

Miss Mary E. Harmon reported on a series of psycho-physical measurements to which 100 normal school girls and 100 kindergarten pupils of both sexes were submitted. The usual questions of age, parentage, etc., and anthropological measurements, were supplemented by tests of sound reaction, free arm movement time, etc. Among the kindergarten children, the girls were found to be much slower in the arm movement test than the boys, the average times being about 215σ and 155σ respectively.

Prof. Wesley Mills reported on personal experiences under ether. He described the narrowing and intensification of consciousness prior to evanescence, and compared it with De Quincey's similar experiences under the influence of opium.

Brother Chrysostom, of Manhattan College, spoke upon a "Preliminary Study of Memory." A set of 30 questions was distributed among various educational institutions; a few have responded already, and these results were reported. The questions were minute and thorough-going; several were devoted to different characteristics of the attention and its individual variations. One inquiry being as to the time of day in which the best work could be done, the answers were found to be about evenly divided between the forenoon and late evening.

Interesting discussion followed the separate papers, but unfortunately the program was so crowded at both this and the Wednesday sessions that this important part of the proceedings had several times to be cut short.

The meetings on Wednesday (December 30th) were held in the Peabody Museum of Archæology at Cambridge. The morning session was devoted largely to historical and theoretical topics. Prof. Armstrong reported on the growth of the study of philosophy in American colleges in the past twenty-five years; he described the great progress everywhere since 1872 in the number of courses, hours and instructors in the department, the broadening and specialization of the courses, and the increase of special foundations and endowments.

Two papers followed on the relation between mind and body. Prof. D. S. Miller summed up the evidence against the theory of psychophysical parallelism, and spoke in favor of Bradley's construction of the causal relation. Prof. C. S. Strong, speaking on the same topic, favored a form of the parallelistic theory which recognized the "efficacy of consciousness"; it was a mistake, he argued, to believe that the parallelistic theory necessarily involved the reduction of consciousness to the rôle of an epiphenomenon.

Prof. Creighton discussed the concept of the "Transcendental Ego," and was followed by Mr. F. C. S. Schiller, who examined the nature of "Pessimism," and Prof. James Seth, who discussed the "Standpoint and Method of Ethics." Two papers devoted to logic were given in outline merely. Prof. J. G. Hibben exhibited and explained a set of diagrams by means of which the various forms of immediate inference were generalized and schematized. Prof. A. T. Ormond summed up his position with regard to the negative in logic.

The session closed with a report by Prof. Sanford on a new eye sphygmograph, which furnishes the best available method (apart from vivisection) of measuring the blood supply of the brain. After describing the apparatus, he exhibited diagrams of records obtained by means of it before and after nervous excitation; these were compared with simultaneous records of the wrist pulse.

The afternoon session was devoted to the Address of the out-going President, Prof. Fullerton. The subject of the address was "The 'Knower' in Psychology." Opening with an historical review of the position taken by various thinkers regarding the agent or subject of knowledge, he proceeded to criticise in detail the theories held by Prof. Ladd and other members of the Association. After the address Prof. Ladd replied to the criticism of his own views.

At the business meeting of the Association, Prof. J. Mark Baldwin, of Princeton, was elected President for the ensuing year, and Dr. Livingston Farrand, of Columbia, was re-elected Secretary and Treasurer. Several new members were elected into the Association, and the two annual vacancies in the Council were filled. The committee appointed at the previous meeting (1895) to formulate a system of uniform physical and mental tests, submitted their report, which was not read in full owing to the lateness of the hour. The committee were unable to agree on a complete system of uniform tests; they recommended that for the present considerable latitude be given within certain broad lines, with a view to comparing various tests, so that the best may eventually be adopted.—H. C. W.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

The American Society of Naturalists met December 29th, at the Harvard Medical School, Boston. The meeting of the affiliated Societies, was fully up to the standard of previous gatherings, both as to the amount of work accomplished and the attendance. The programs of the societies were full, the physiologists especially showing an important increase in the number of workers. Several young men presented maiden papers of merit to the morphologists; while the merits of the opposed theories of psychic parallelism and interference in animal evolution were discussed by the psychologists among the topics before them. The discussion of the inheritance of acquired characters was made the subject of the special discussion by the naturalists, and, although the subject is not new, a large audience was present, the other societies, excepting the physiologists, adjourning to attend it. Profs. Minot and James, of Harvard University, took the negative, and Macfarlane and Cope, of Pennsylvania, the affirmative. It was generally regretted that more time had not been alloted to the discussion, so as to have enabled others to take part in it. The evening dinner was closed by an interesting address from the President, Prof. Scott, of Princeton, an innovation which we hope will become the regular custom.

The following is the program of proceedings: Reports of Committees; Election of New Members; Appointment of Special Committees; Discussion, subject: "The Inheritance of Acquired Characteristics;" "Zoology," Prof. C. S. Minot; "Botany," Prof. J. M. Macfarlane; "Paleontology," Prof. E. D. Cope; "Psychology," Prof. Wm. James; Special Papers.

Prof. C. S. Minot opened the discussion on heredity, suggesting the wide interest in the solution of the problem of whether characters acquired during the life of the parent were transmitted to the offspring. It was well illustrated in the popular beliefs that correct habits of life or the opposite, in parents, had an important influence on the character of children, leaving out of the question the force of example. To many the incentive to right living was centered largely on the bearings of the matter on education of the young.

The scientific data, however, on which to base a theory, was most meagre in amount and unsatisfactory in character. Much of the reasoning had to be in assumptions, which were but sparsely indicated in the evidence. The characters generally of an individual were largely the result of many generations of development, and were the last term of a series, each part of which had a causal relation to the result.

Several specific characters were taken up by the speaker, as the development of the facial nerve in the embryo, cases of false articulation forming in luxated joints, characters in the Papilio genus of butterflies, and some other instances. It was urged as an observation that all normal parts, whether hard or colored or otherwise highly differentiated from the germ, seem to follow a predetermined plan in the development of the individual, and, in the history of a species, and have a tendency to differentiate in series. The presence of series it was therefore, argued is no evidence of the transmission of acquired characters.

An elaborate presentation of the two theories of the primal unit of life was entered into, detailing first the views of investigators who regarded the start as a small, discrete, homogenous particle gifted with considerable locomotive power, and thus capable of conveying impressions from the outside of the subject to the more remote precincts of the germ within. Opposed to these were theories to which the speaker adhered, which assumed the unit to be the cell, relatively large, of a various chemical constituency and with something of an organization. The first of these two theories permitted the further step of assumption that acquired impressions could, by the greater facility in movement, reach the germ, while the second theory found the germ rather removed from outside impressions, and tending generally to perpetuating the type or the result of accretions from a long previous series of experiences and impressions. Prof. Minot was thus opposed to the idea of transmission as defined in the question.

Prof. J. M. McFarlane was in favor of the theory of transmission, drawing his data from botanical studies in an exhaustive review of the vegetable kingdom. His arguments were directed mainly to examples of changes in genera and species from changes in environment, and a lot of evidence was adduced having some relation to the transmission of acquired characters, but mainly to showing the prompt response in nature to the influence of surroundings.

Prof. Cope's defence of the doctrine of the inheritance of acquired characters was selected from the evidence contained in his book, "The Primary Factors of Organic Evolution." He referred especially to the history of the moulding of the articulations of the vertebrate, and especially the Mammalian skeletons, of which such complete series has been furnished by paleontology. The forms of these articulations he believed to be the result of their movements, for the reason that they could be formed artificially as the result of experiment, or in consequence of luxations. He believed that the resulting forms have been inherited, because they are found in the embryo, before the animal has had an opportunity of developing the structure for himself by interaction with the environment.

He admitted the justice of Dr. Minot's demand for an explanation of this phenomenon. He stated that the preformationists offered no explanation ; and, indeed, so far as he could see, none is possible from their point of view. The epigenesisists could, on the contrary, appeal to the phenomena of memory as a plausible explanation. Stimuli from without and within the organism leave a record in the brain-cells, which give the form to consciousness when the latter invades them along the guiding lines of association. Why should not the germ plasma be capable of a similar record of stimuli, which is expressed in the recapitulatory growth of the embryo? He thought that the evidence pointed to such a process. These stimuli affected the soma and the germ plasma simultaneously, in accordance with the doctrine of Diplogenesis; but that the soma only records results in each tissue which are appropriate to the functions of the same, while the germ plasma and brain-cells may record them all. The certainty of record in both cases he supposed to depend on the frequency and strength of the impression, as is known to be the case with the memory of the mental organism. Hence mutilations or single impressions were rarely recorded, while those due to the constant and habitual movements are recorded, and furnish the physical basis of growth and of evolution of type.

He further remarked that the belief that natural selection originates structure could not be entertained, as paleontological evidence shows that evolution has proceeded by very gradual additions and subtractions of character, which required long periods to become of any value in the struggle for existence—sometimes an entire geological period being occupied in the elaboration of a character to structural usefulness.

Finally, he referred to the physical mechanism of mental phenomena, and stated that some psychologists require a completed machine in order for the performance of special mental function. The speaker called attention to the fact that it is highly probable that the fundamental sensations do not even require a nervous system for their expression. Thus Protozoa appear to experience the sensations of hunger, temperature and the muscular sense of resistance. Hence, it is as true of the physical basis of mental as of other functions that the formation produces the structure, while structure merely specializes or perfects function.

Professor Wm. James followed from the psychologic point of view. He said that the brain was evidently an organ capable of great variability of function, and that variations in new directions were frequent. He regarded genius as a form of sporting, and that such sports frequently served as guides to the development of human society. He believed that education was of primary importance, and did not find much evidence of the inheritance of characters acquired in this way. He believed on the contrary that mental acquisitions are transmitted from generation to generation by education and by imitation, a process which Prof. J. Mark Baldwin had termed "Social Heredity."

At 8.15 P. M. the Society attended at the Fogg Museum of Art, Harvard University, Cambridge, a lecture by Mr. Alexander Agassiz, on "The History of Deep Sea Explorations;" and at 9.30 P. M. attended a reception by Mr. Alexander Agassiz, at his residence on Quincy Street, Cambridge.

On Wednesday, December 30th, 12 M., the Society attended at the Fogg Museum of Art, Harvard University, Cambridge, a lecture by Prof. E. B. Wilson, on "Recent Developments of the Cell Theory; at 1.30 P. M. was served at the Faculty Rooms, University Hall, Cambridge, a luncheon, by invitation of the President and Fellows of Harvard College. Two addresses were delivered in honor of the Fiftieth Anniversary of the arrival of Agassiz in Cambridge, by President Elliott and Prof. Wm. James. At 3 P. M., Mr. Alexander Agassiz met the Society in the Museum of Comparative Zoology, and described the Museum; and at 6.30 P. M., Hotel Brunswick, corner of Boylston and Clarendon Streets, Boston, a business session was held. At 7 P. M. the annual dinner of the Affiliated Societies took place at the Hotel Brunswick, at the close of which the societies listened to the address of the President, Prof. W. B. Scott.

American Physiological Society.—Program: Tuesday, December 29th, at the Harvard Medical School, General Business; Reading of Papers: W. T. Porter, "Studies in the Physiology of the Mammalian Heart:" T. Hough, "On the Duration of Cardiac Standstill with Different Strengths of Vagus Stimulation;" R. Hunt, "Some Experiments on the Relation of the Inhibitory to the Accelerator Nerves of the Heart;" W. H. Howell, "Exhibition of Plethysmographic Curves Obtained During Sleep, with Remarks;" H. P. Bowditch, "The Relation between Height, Weight and Age in Growing Children;" C. S. Minot, "An Experiment on Telegony;" S. J. Meltzer, "On the Contraction of the Stomach Produced by Direct Stimulation and by Stimulation of the Vagi with the Faradic Current;" Fr. Pfaff, "An Experimental Investigation of Some of the Conditions Influencing the Secretion and Composition of Bile" (With Mr. A. Balch); G. Lusk, "The Production of Sugar from Gelatine in Metabolism;" W. T. Porter, "Demonstration of a Method for the Isolation of the Mammalian Heart;" S. J. Meltzer, "Demonstration of the Reaction of the Stomach to Faradic Stimulation;" G. T. Kemp, "Demonstration of a Convenient Form of Apparatus to Avoid Explosions in Gas Analysis."

Wednesday, December 20th, at Harvard University, Cambridge, General Business; Reading of Papers: G. C. Huber, "The Structure of the Sympathetic Ganglia of Vertebrates, with Demonstration of Preparations;" G. C. Huber, "Remarks on the Ending of Nerves in Muscle Tissue, with Demonstrations;" W. Mills, "The Functional Development of the Cerebral Cortex in Different Groups of Animals;" R. H. Cunningham, "The Restoration of Coordinate Power After Nerve Crossing;" R. H. Chittenden, "The Proteolytic Action of Papain;" C. F. Hodge," Experiments on the Physiological Influence of Alcohol;" G. T. Kemp, "The Physiological Action of Nitrous Oxide;" S. J. Meltzer, "On Bactericidal Effects of Lymph from the Thoracic Duct" (with Dr. Charles Norris). G. W. Fitz, Demonstration of Apparatus: 1, A spring cylinder chronograph for spark records; 2, A lever system to illustrate the action of muscles in relation to joints; 3, A form of student's myograph; 4, A modification of the location reaction apparatus. C. F. Hodge (for C. C. Stewart), Demonstration of preparations of the nerve cell under acute alcoholic poisoning. General Business.

The American Morphological Society.—Boston, December 29, 1896.—The following papers were read: Arnold Graf, "On the Individuality of the Cell." Maintained the individuality of the cell pointing out the existence of organs in it. A. D. Mead, "On the Centrosomes of Chætopterus." Pointed out the existence of primary and secondary centrosomes in the unfertilized egg, the latter arising from the reticulum of the cytoplasm. These form the centers of spindles, and these spindles divide. History of the egg centrosome during maturation traced, and at the close of the formation of the second polar globule it occupied a position in center of chromosomes. Author was not certain of the origin of the male centrosome. F. R. Lillie, "Origin of the Center of the First Cleavage Spindle in Unio complanatus. This form is unlike Myzostoma in that it has male and female asters; but the centrosome of segmentation, like that of Myzostoma, arises from the female. E. B. Wilson, "Centrosome and Middle Piece in the Fertilization of the Egg." In Toxopneustes the centrosome arises not from the middle piece, but from a point between this and the head of the spermatozoan. H. E. Crampton, Jr., "Observations on the Fertilization in Gasteropods." Largely a confirmation of a paper by Mead. Miss Byrnes, "Maturation and Fertilization of Limax." C. S. Minot, "A New Microtome; New Laboratory Methods." Method of sharpening microtome knives—exhibited serial sections 2μ thick cut with the new microtome and with knives sharpened with adamantine by a laboratory boy. He advised filtering of all waste paraffine in the laboratory. W. Patten, "Preservation of Cartilage, etc., in a Dry Condition." By impregnetion with paraffine as if for section work. C. B. Davenport, "The Role of Water in Growth." Careful weighing of frog embryos shows that in early stages increase in weight is almost entirely due to absorption of water. J. P. McMurrich, "Structure and Function of the Hind Gut of Isopods." This region is lined with solid chitinous intima; does not increase in number of cells; does not absorb food. Dr. Conkin contradicted this, claiming that the intima is traversed by fine canaliculi, that food is absorbed by this region, and that its cells divide in the length of the animal by amitosis.

December 30, 1896.—H. C. Bumpus, "The Result of the Suspension of Natural Selection as Illustrated by the Introduced English Sparrow." Showed by comparison of 1600 eggs that this bird is more variable in the United States than in England. G. W. Field, "The Plankton of Brackish Water." A. E. Verrill, "Nocturnal Protective Colors of Amimals." On diurnal changes in colors of fishes as related to natural selection. Margaret Lewis, "Epidermal Sense-Organs in Certain Polychaetes." Structure and distribution of these in some maldanids. A. P. Henchman, "Eyes of Limax maximus." Details of structure and existence of primary and accessory visual organs. A. Schaper, "Earliest Differentiation of the Central Nervous System of Vertebrates." A history of the epithelial sustentation, glia and nerve cells in the spinal cord; and a parallel between ontogeny and the conditions found in amphroxus, lamprey, selachian, etc. W. Patten, "A Basis for a Theory of Color Perception." Based upon the wave lengths and the conical shape of the end-organs. N. P. Harrington, "A New Species of Entoconcha and the Systematic Position of the Genus." A. E. Verrill, "A Colossal Cephalopod from Florida." An octopus with body 18 feet long, 5 feet in diameter; estimated weight of this part, 5 tons. Part of one tentacle was found 34 feet long and 10 inches in diameter at the place where it was broken of. Its length in life is estimated between 70 and 90 feet. G. Lefevre, "Budding in Clavellinidæ." W. Patten, "Visual Centers of Vertebrates and Arthropods." An attempt to homologise these regions in the two groups. M. Bancroft, "Notes on Chelyosoma." J. S. Kingsley, "Amphiuma and the Caecilians." Claimed that these two forms are but remotely related to each other. F. C. Waite, "Brachial and Lumbo-Sacral Plexi in Necturus." The evidence presented by these structures upon vertebral intercalation and on the shifting of the pelvis.

The Society elected the following officers for the coming year: President, C. S. Minot; Vice-President, S. I. Smith; Secretary-Treasurer, G. H. Parker; Executive Committee, J. S. Kingsley, Bashford Dean. Many papers were left unread on account of lack of time. Probably, in the future, papers will be admitted only from actual members; they will be limited to fifteen minutes; and the authors will be requested to omit all historical reviews and details of observations, and to confine themselves to the broader conclusions and generalizations.

Boston Society of Natural History.—January 6, 1897.—The following papers were presented; Mr. A. W. Grabau, "The Sand Plains of Truro, Wellfleet and Eastham;" Prof. W. M. Davis, "A Geographical Classification of Coastal plains."—Samuel Henshaw, *Secretary.*

January 20.—The following paper was read: Prof. W. O. Crosby, "The great fault and accompanying sandstone dikes of Ute Pass, Colorado."—Samuel Henshaw, *Secretary.*

New York Academy of Science, Biological Section.—December 14, 1896, Prof. J. G. Curtis, Chairman, in the Chair. Dr. Arnold Graf made a preliminary report on "Some New Fixing Fluids;" Mr. J. A. McGregor read a paper entitled "An Embryo of *Cryptobranchus.*"

The embryo described is about 16 millimetres long, and is the first to be recorded of this species.

Prominent among its external features are the excessive amount of yolk, the marked ventral flexure in the cervical region, and the very early and almost simultaneous appearance of the two pairs of limbs. The dorsal surface is pigmented, the pigment cells being arranged in transverse bands, one band over each metamere of the body. Lateral line sense-organs can be distinguished. Among the most striking internal characters may be mentioned the dorso-ventral flattening of the notochord, the late appearance of entoderm and alimentary organs generally—due doubtless to the great mass of the yolk. The primordial skull is unusually well-developed. The auditory vesicle has an endolymphatic duct ending blindly immediately under the skin on the top of the head. Along the sides of the body a system of organs occur which are probably homologous with the embryonic sense-organs described by Beard in the sharks.

Dr. J. L. Wortman spoke of the "*Ganodonta,*" a new and primitive suborder of the Edentata from the Eocene of North America. One section or family of the suborder, viz., the Stylinodontidæ, is composed of *Hemigamus*, *Psittacotherium*, *Ectoganus* and *Stylinodon*, and forms a closely connected and consecutive phylum, reaching from the base of the Puerco to the Bridger formation, and leading directly to the Gravigrada or ground sloths. A second family, viz., the *Conoryctidæ*, composed of *Conoryctes* and *Onychodectes* may be regarded as ancestral to the Armadillos. The character and origin of the Edentate fauna of South America was discussed at length, and the conclusion reached that its original home was in North America. It was further held that there was a migration to the southward before the close of the Eocene, and that there must have then been an early land connection between the two continents.—C. L. BRISTOL, *Secretary.*

University of Pennsylvania Biological Club.—Monday, January 4th, Program. Demonstrations: " Descriptive Demonstration of the Life-History of Sacculina, H. Heath. Reviews: " Zoological," Drs. Moore and Calvert; " Chemical," Dr. Mary E. Pennington; " Pathological," Dr. Ferree Witmer; " Botanical," Dr. Macfarland, Mrs. Wilson. (Time limit for each review, five minutes.) Original Communication, by Dr. Edw. D. Cope, " The Embryonic Appendages and the Evolution of Mammalia."—H. C. PORTER, *Secretary.*

January 18.—Program Demonstration, Cell changes in Spirogyra grown under color-screens, Dr. Mary E. Pennington: Review.—Zoological: Dr. P. Calvert, Chemical; Dr. Mary E. Pennington, Botanical; Dr. J. Harshberger, Original Communications.—Account of the Boston meeting of the Society of American Naturalist and Affiliated Societies. Profs. Macfarlane, Conklin, Witmer, and Cope.—H. C. PORTER, *Secretary.*

The Biological Society of Washington.—January 2, 1897.—The following communications were made: " Brief Informal Notes and Exhibition of Specimens," (All the members are cordially invited to take part); E. W. Nelson, " New Birds from Mexico;" F. A. Lucas, " On the Natural Mortality Among Fur Seals;" C. Hart Merriam, " On the Pribilof Island Hair Seal;" W. H. Dall, " Notes on the Molluscan Fauna of the Pribilof Islands."—FREDERICK A. LUCAS, *Secretary.*

January 16.—The following communications were made: David White, " A New Lycopodineous Cone from the Coal Measures of Missouri;" David White, " Unity or Plurality of Type Specimens in Paleontology;" Edward L. Greene, " Development of the Idea of a Genus;" M. A. Carleton, " Ontogenetic Separation of *Puccinia graminis avenæ* from *P. graminis tritici.*"—FREDERIC A. LUCAS, *Secretary.*

Cincinnati Society of Natural History.—At the monthly meeting, January 5, 1897, the following communications were made: "On the Pulsation of the Molluscan Heart," by Frank C. Baker, of Chicago; "Catalogue of the Odonata of Ohio—Part III," by D. L. Kellicott, of Columbus, O.; "An Odonate Nymph from a Thermal Spring," by the same author. (All three papers will be published in the "Journal" of the Society.—JOSUA LINDAHL.

The Academy of Science of St. Louis.—At the meeting of the Academy of Science of St. Louis, on the evening of December 21, 1896, Mr. H. von Schrenk made some remarks on the parasitism of lichens, illustrated especially by the long hanging forms of *Usnea barbata*, common on Juniperus, etc., on Long Island, N. Y. It was shown that these lichens do not penetrate below the outer periderm of the host, and consequently are not to be regarded as true parasites, but that they frequently cause the death of the latter by suffocation. As Schimper has noted for the long moss of the South, *Tillandsia usneoides*, the plant is capable of dissemination by wind and birds, and of growing in new stations without attachment. Officers for 1897 were nominated.

January 4, 1897, Dr. Amand Ravold gave a microscopic demonstration of Widal's test for typhoid fever, demonstrating that after the disease has existed for four days or more the blood of typhoid patients, probably because of some contained antitoxine, possesses the power of inhibiting the motion of typhoid bacilli from a pure culture introduced into it within a period of one hour or less, whereas in normal blood similar bacilli retain their power of locomotion for an indefinite length of time. It was stated that typhoid blood possessed this property even after having been dried for a period of four weeks or more, so that a few drops obtained from a person suspected of having the disease may be sent to suitable places for applying the test, thus rendering comparatively easy the early diagnosis of a disease, which, in its early stages, presents many clinical difficulties.

Professor F. E. Nipher gave preliminary results of partially completed experiments, made through the courtesy of the Burlington and Illinois Central Railroads, to determine the frictional effect of trains of cars on the air near them. His apparatus consists of a cup collector supported on a bar capable of sliding in guides on a clamp attached to the window-sill of the car. The bar is thrust out to varying distances up to 30 inches. The mouth of the collector is turned in the direction of motion of the train. The pressure due to the motion is conveyed through a rubber tube attached to the rear of the collector, and passing lengthwise through the car to a water monometer. The monometer has a tube with a rise of 4 or 5 in 400, and is provided with a pivotal mounting and a level.

The pressure near the train is comparatively small, and increases as the collector is thrust further out. It approaches a limit corresponding to the train velocity at the instant. Professor Nipher finds the relation between the limiting pressure and velocity to agree exactly with the formula $P=\frac{S}{2}v^2$, where v is the train velocity in centimeters per second, P is the pressure in dynes to the square centimeter, and S is the density of air in C. G. units at the temperature and pressure of the observations. He finds the pressure a maximum when the axis of the collector is parallel to the direction of motion with the mouth to the wind. Turning the collector until the axis makes an angle of about 80° with this position, the pressure reduces to zero. At greater angles the pressure becomes less than atmospheric pressure by an amount which reaches a maximum at the angle of 90°, and passes through a minimum at an angle of 80°, when the collector is in a trailing position. The sum of the coefficients for the two positions of maximum compression and minimum exhaust is almost exactly the same as Langley obtained with a pressure board when exposed normally to the wind.

The result shows that a large amount of air is dragged along with the train, the motion being communicated to air many feet away. This air is a source of danger to one standing too near the train when at full speed. One is likely to be toppled over, and the blow of the air communicates a motion of rotation, which may cause one to roll under the train if the nature of the ground does not prevent such a result. It was remarked, however, that where trains have a right to run at any speed, no prudent person would stand so near to a train as is necessary in order to be in danger from this source.

The following officers were declared elected for the year 1897 : President, M. L. Gray ; First Vice-President, E. A. Englar ; Second Vice-President, Charles R. Sanger ; Recording Secretary, William Trealease ; Corresponding Secretary, F. C. Runge ; Treasurer, Enno Sander ; Librarian, G. Hambach ; Curators, Julius Hurter, J. H. Kinealy, E. Evers ; Directors, M. H. Post, Joseph Grindon.

One person was elected to active membership.—William Trealease, *Recording Secretary.*

Nebraska Academy of Sciences.—The Seventh Annual Meeting was held at Lincoln, December 29, 1896, with the following program :

Presidential Address by Prof. E. H. Barbour on "Academies of Sciences, their Economic and Educational Value," with suggestions for the improvement of our Academy; "A New Plankton Pump" for collecting aquatic organisms from any desired depth, H. B. Ward and Charles Fordyce; "Continued Biological Investigations," H. B. Ward; "Progress in the Study of the Fauna of the State" showing the richness of our fauna and how little it is known, Lawrence Brunner; "Some Methods of Collecting, Preserving and Mounting Fossils," Carrie A. Barbour; "Nomenclature of Nebraska Trees" with the history of particular names, Charles E. Bessey; "Reflections on the Genus *Ribes*" importance of recognizing the validity of species created by the gardener, F. W. Card; "Chalcedony-lime Nuts of the Genus *Hickora* from the Bad Lands of Nebraska," E. H. Barbour; "Comparison between Nebraska Diatomaceous Earth and that from Neighboring States," C. J. Elmore; "What is Mathematics" and how it correlates other sciences, E. W. Davis; "A Family of Quartic Surfaces," the sum of the distances of whose locus from two given surfaces is constant, Robert E. Moritz; "A Form of Weir Notch," giving a flow of water varying directly as the head, instead of following the usual more complicated law, O. V. P. Stout; "An Observation on Annual Rings in Tree Growth" when complete defoliation did not induce the growth of a second ring, F. W. Card; "Internal Temperature of Trees" rising as high as 119° at a depth of half an inch in a trunk exposed to sunshine, R. A. Emerson. The remaining papers, owing to the lateness of the hour were read by title only, as follows: "Notice of Two Important Books on Systematic Botany," Charles E. Bessey; "The Barites of Eastern Nebraska and the Bad Lands," Erwin H. Barbour; "Some Data as to Wind Distribution of Seeds," Ed. M. Hussong; "Parasites of Nebraska Dogs," Henry B. Ward; "Discovery of the First Meteorite in Nebraska," Erwin H. Barbour; "Notes on Phyllopod Crustacea," H. A. Lafler and A. S. Pearse.

The following officers were elected: President, Dr. A. S. Von Mansfelde; Vice-President, Dr. E. H. Barbour; Secretary and Treasurer, Prof. G. D. Swezey; Custodian, Prof. Lawrence Bruner; Directors, Dr. H. B. Ward, Prof. H. B. Duncanson, Mr. C. J. Elmore and Dr. H. Hapeman.

The next Annual Meeting will be held on the day following Thanksgiving. The volume of Proceedings for 1894–1895 has just been issued, price 40 cents.—G. D. SWEZEY, *Secretary.*

The Botanical Seminar of the University of Nebraska.—December 5, 1896.—The following papers were presented: Mycological Statistics of Nebraska, Mr. Roscoe Pound; The Comparative Anatomy of the Pistil in Apocarpous Families, Mr. Ernst Bessey: Phytogeographical Notes from Colorado, Mr. C. L. Shear. December 26th.—The Polyphylesis of the Lichens, Mr. F. E. Clements; The Phytogeography of Nebraska, Mr. Roscoe Pound: The Flora of Roberts County, South Dakota, Prof. D. A. Saunders; Washington and its Botanists, Mr. A. F. Woods.

Botanical Seminar of the City of Washington, D. C.—December 12, 1896.—The following papers were presented: Short Notices of Current Literature; Synopsis of the Genus Chætochloa, J. G. Smith; The Origin and Development of Sexuality and Alternation of Generations, Considered from the Modern Cytological Standpoint, W. T. Swingle; Some Cases of Polyembryony, A. J. Pieters; Manufacture of Cereal Foods, Mr. A. Carleton.

Torrey Botanical Club.—At the meeting of Tuesday evening, December 8, 1896, thirty persons were present and one new active and seven corresponding members were elected. The death of Mr. Wm. H. Rudkin, one of the oldest members of the club, was announced by Dr. Britton, and a committee was appointed to take suitable action. It was resolved that a complete list of the corresponding members should be printed in the December number of the *Bulletin.* A contribution by Dr. T. F. Allen, entitled "Descriptions of New Species of *Nitella* from North America and Japan," was read by title by Dr. Britton in the absence of the author. Mrs. Elizabeth G. Britton presented a "Contribution to the Bryology of Bolivia." It reviewed the more important collections of Bolivian mosses, the treatment which they had received and the present work in progress on this subject, and enumerated the bryological collections made by Dr. Rusby in Bolivia in the years 1885 and 1886. This collection contained 96 species, in 39 genera, 42 of the species being hitherto undescribed. Dr. H. H. Rusby spoke of "Botany at the Pan-American Medical Congress held in the City of Mexico, November, 1896." This paper contained brief references to the character of the flora observed on the journey to Mexico, an account of the scientific progress in the city, especially pertaining to applied botany and referred to the botanical work organized by the Pan-American Medical Congress. It was supplemented by remarks upon the same subject by Mrs. Britton, who also attended the Congress. A number of important publications by the *Instituto Medico Nacional* were exhibited. Dr. N. L. Britton described a new species of Geranium hitherto confounded with *G. Carolinianum.* The papers by Dr.

Allen and Dr. and Mrs. Britton will be published in the *Bulletin*, that by Dr. Rusby in the *Druggists' Circular*. On motion the Club adjourned to meet on the second Tuesday in January.

H. H. Rusby, *Rec. Secretary.*

Chicago Academy of Sciences.—A regular meeting of the Academy of Sciences was held Tuesday evening, December 22, 1896. Prof. Willis L. Moore was elected a corresponding member. Mr. Frank M. Woodruff, Ornithologist of the Academy, read a paper on "*Recent Occurrences of Rare Birds in Chicago.*"

The speaker remarked that he had been collecting data and specimens during the past year for the Ornithological Report of the Geological and Natural History Survey, and had been fortunate enough while engaged in this work to run across a number of rare species. The most favorable time for collecting these rarities is when Lake Michigan is almost frozen over, or during the months of January and February, after the wind has changed from an easterly direction and is blowing from the west. The east wind breaks up the ice and the west wind drives the broken floes away from the shore, leaving at times a long stretch of clear water, with here and there a small patch of ice; in this open water the ducks and gulls gather by thousands to feed upon dead fish and sewerage, and they may then be collected very readily. Many of the birds gathering here at this time are inhabitants of Alaska and Northern British America.

The rarest bird taken was a specimen of an immature male Kittiwake Gull (*Rissa tridactyla*) which was shot by Mr. Wagner on the 9th of December near Lincoln Park. This is the first record of a specimen of this bird being shot in Illinois. Barrows Golden-eye (*Glaucinetta islandica*) was seen recently in large flocks, and two specimens were shot, one of which got away, but the other was captured and is now in the Academy's collection. This species is rare, and there are but few records of its capture. The Old Squaw (*Claugula hiemalis*) is seen commonly about Chicago, but is seldom taken. Mr. Woodruff mentioned the following additional more or less rare species: White-winged Scoter (*Oidemia deglandi*); Velvet Scoter (*O. fusca*, at Meredosia); Robin Snipe or Knot (*Tringa canutus*); Buff-breasted Sandpiper (*Tryngites subruficollis*); Baird's Sandpiper (*Tringa bairdii*); Piping Plover (*Ægialitis meloda*); Black-bellied Plover (*Charadrius squatarola*); Stilt Sandpiper (*Micropalama himantopus*); Willet (*Symphemia semipalmata*); Turnstone (*Arenaria interpres*); Harlan's Hawk (*Buteo borealis harlani*) and American Goshawk (*Accipiter atricapillus*). The

Little Yellow Rail (*Porzana noveboracensis*) was mentioned, not as being rare, but as seldom collected, probably on account of its small size and skulking disposition.

The paper was illustrated by specimens of the species spoken of belonging to the Academy and Mr. Woodruff.

Frank C. Baker, *Secretary.*

SCIENTIFIC NEWS.

It will be of interest to Botanists and Zoologists to learn that a Biological Survey of Alabama has been organized and put into operation. The Survey will be carried on under the auspices of the Alabama Polytechnic Institute, and will be named by the specialists engaged at that institution in the various lines of biological investigation. It will have for its object the study in field and laboratory of all plants and animals occurring in the state and of the various conditions effecting them. The work will be done systematically and thoroughly and all results published. In a region so interesting and little worked as this portion of the Southern United States, careful and extended research will be sure to yield results of the greatest value. Large quantities of material in all groups of plants and animals (especially insects) will be collected and properly prepared. In connection with the Survey there has been founded an Exchange Bureau, from which will be distributed all duplicate material. Anyone desiring to correspond relative to specimens, literature, or work of Survey, should address *The Alabama Biological Survey, Auburn, Alabama.*

The New Monthly Open Court.—With January, 1897, the Chicago *Open Court* celebrates the decennial anniversary of its nativity and more consonantly with the solid character of its contents now appears in the form of a monthly instead of a weekly. Undoubtedly this change will gain more than ever the attention of thoughtful people for *The Open Court,* which is devoted to the high ideal of purifying religion by the methods employed in science,—an aim which it has always reverently but fearlessly pursued.

In the ten years of its existence *The Open Court* has gained the hearty co-operation of a majority of the world's most eminent scientists and thinkers, both orthodox and unorthodox. The subscription-price to *The Open Court* being reduced to an absolute minimum, its work has been rendered possible only by the large private endowments of Mr. E. C. Hegeler of La Salle, whose contributions to its support have exceeded its net income by ninety-six per cent.

In the present opening number besides the Salutatory of the editor expounding the purpose of *The Open Court,* is an extremely significant controversy on Buddhism and Christianity between the Right Rev. Shaku Soyen, delegate of Japan to the Chicago Parliament of Religions, the Rev. Dr. John Henry Barrows, Chairman of the Parliament, and the Rev. F. F. Ellinwood, a prominent Presbyterian clergyman of New York,—a literary symposium realising the idea of a Parliament of Religions extension. A powerful sermon on "Trade and Usury" by Martin Luther, skilfully translated by Professor Carruth, a valiant defence of the claims of Science in Theology by Dr. Cornill, Professor of Old Testament history in Königsberg, Germany, Notes and Reviews of important books complete the contents. With the promise of the first number and its old reputation, *The Open Court* is assured of increased and abiding success. (Annual subscription, $1.00: The Open Court Publishing Co., Chicago.)

Mr. Herbert Spencer.—Mr. F. H. Collins, of Edgbaston, forwards an address of congratulation to Mr. Herbert Spencer upon the completion of his "System of Synthetic Philosophy," signed by more than 80 noblemen and gentlemen eminent in public life, in literature, and in various branches of learning and science. The signatories request Mr. Spencer to permit them to employ some eminent artist to take his portrait, with a view to its being deposited in one of our national collections. Mr. Spencer, in a letter to Sir Joseph Hooker, complies with the request thus made, explaining the reasons which formerly led him to refuse a similar proposal. Mr. Herkomer, R. A., has undertaken to paint the portrait.

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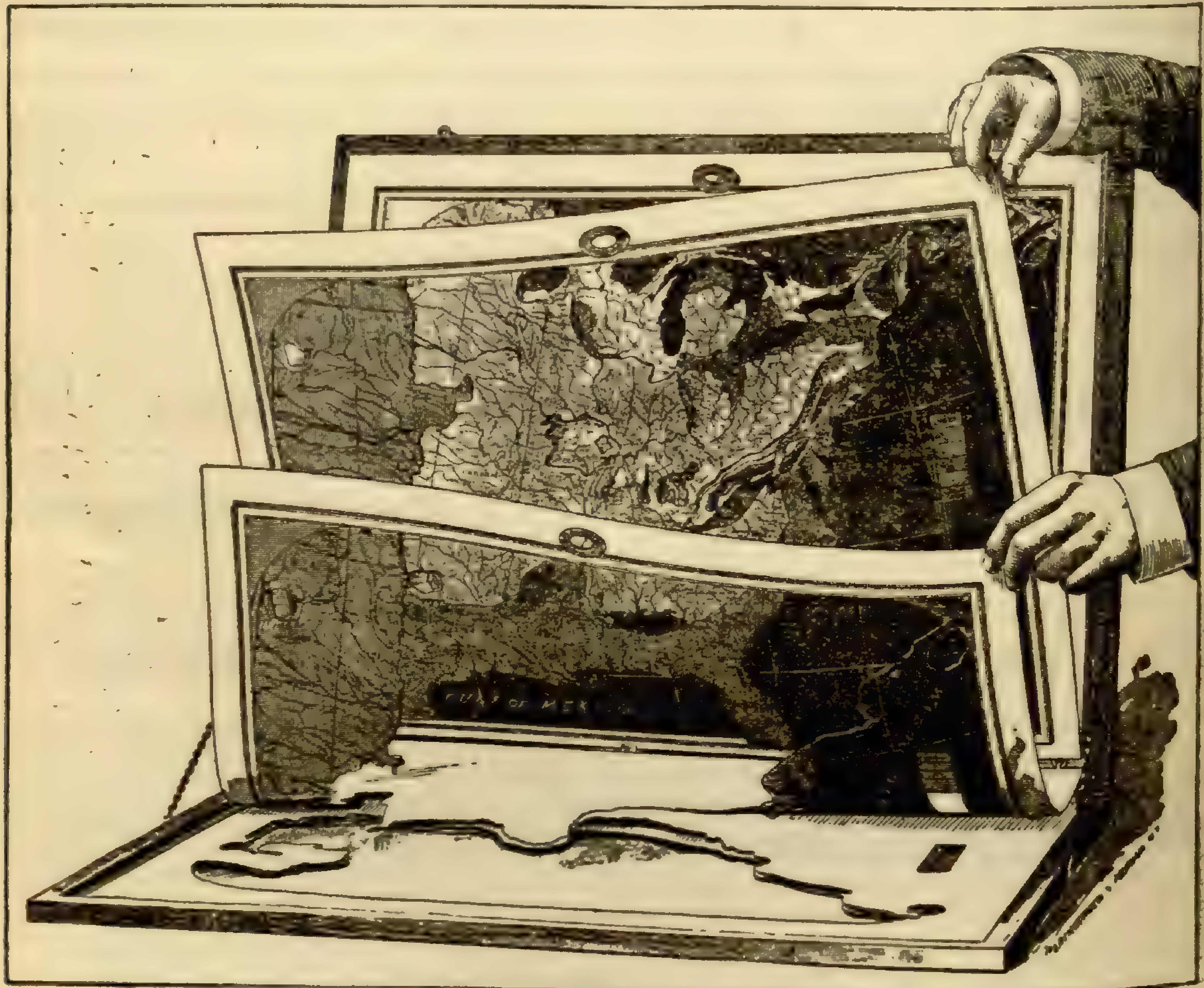

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AMERICAN NATURALIST

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FOSSILS AND FOSSILIZATION.

BY L. P. GRATACAP.

IV.

(*Continued from p. 33.*)

As regards their degree of preservation the nature of the deposit has some influence upon the condition of fossils; and the nature of a deposit involves also a suggestion of its position, as we have seen, whether subject to estuarine vicissitudes, tidal fluctuations, or the ceaseless attrition of shore waves. When we examine the sandy and gravelly deposits of the Potsdam (Cambrian), the Medina (Upper Silurian), the Chemung and the Catskill (Devonian), the coarse conglomerate of the Lower Carboniferous, or the calcareous grits of the Schoharie and Oriskany (Lower Devonian) we find a reflexion of their physical character in the condition of the fossils preserved in them. The trilobite layers of Wisconsin and Minnesota in the Upper Cambrian (Potsdam) are crowded with the separated parts of these crustacea, whose delicate articulations were unable to resist the friction they were exposed to in the motions on a beach of siliceous sand. Neither does a sandy beach receive impressions with ease and certainty, as the indistinct outlines of the trilobites in these beds show. Furthermore, in a siliceous bed, more or less percolated through by water, the water has dissolved the calcitic or lime parts of these animals, since they were not protected against this depletion by the presence of a calcareous matrix, unless, as with *Obolella polita*, at Trempeleau, Wisconsin, the great numbers of the fossil itself acts as a protection against solution and attrition. The influence of a slight admixture of a plastic ingredient in improving the casts and impressions of fossils is seen in the more argillaceous layers of the Cambrian beds, as at Mazomania, Wisconsin, where *Aglaspis barrandii* and *Dicellocephalus minnesotensis* are retained with a firmer and more legible outline. In many layers the Obolellas are broken, and appear as shelly fragments scattered over the rock. The Obolella is also a compact and small object, protected to some extent by the convexity of its valves; but where it is preserved in perfection we may reasonably conclude, like the little *Gemma gemma* of our coasts, it had buried itself in the sand, and was not expelled from its safe position by waves or denudation. The regular close distribution of these fossils over the slabs of Potsdam sandstone show that they suffered little or no displacement. On the other hand, the fragments of Ptychoparia (trilobite) in the same rocks at Trempeleau, Kickapoo, prove from their heterogeneous, confused interference of parts, some drifting, rubbing and dislocation. The *Lingulepis pinniformis*, a delicate shell, and with valves held together by ligaments alone, occurs in great numbers in the sandy Potsdam beds of St. Croix, and in a very good state of preservation; in some instances, the concentric lines of growth, the polished and corneous surface being retained. But, for the most part, the individual shells have suffered from friction and breaking. *Lingulella stoneana* in the red beds of Mazomania are flattened and disfigured. But in the green slates of Braintree, Mass., *Paradoxides harlanii*, a trilobite, is well preserved, except where distortion from compression and lateral motion has strained and deformed the parts. Similarly another crustacean, *Olenellus*, in the less dense slates of Georgia, Vt., also Lower Cambrian, is found quite well preserved, but suffering mutilation and almost obliteration at times, from the metamorphic pressure by which these aluminous muds were transformed into fissile shales. In the annelid, green paper shales of Waterville, Kennebec River, Maine, the serpentine markings of what has been referred to a worm are well preserved. In the Medina sandstone, a red ferruginous sandstone of the Upper Silurian age, the fossils are poorly preserved, lacking fullness of contour and seldom showing the surface characters with any distinctness. Lyell collected oyster shells and Buccinum thrown up by a storm on the shore of the estuary of the Forth, Scotland, and observed that "although still living, their shells were worn by the long attrition of sand which had passed over them, as they lay in their native bed, and which had evidently not resulted from the mere action of the tempest, by which they were cast ashore." The fossils of the Medina sandstone show abrasion, and in most cases present a rude cast of sand, made by the filling in of the shell, without muscular markings, and often with shrunken outlines, as if the sand filling had contracted. Wet sand, occupying the interior of a shell, must, upon drying, undergo some contraction, and being less apt to contract equally than clay or a calcareous paste, reproduces its mould less perfectly. The finer grained sandstone, however, and those somewhat more coherent, from the intermixture of lime or clay, are better adapted for the retention of fossil bodies and impressions. Thus, the Chemung sandstone (Upper Devonian) is a variable mixture of sand and carbonate of lime, and is introduced in a series of shales and siliceous limestones, whereby, as it formed a contiguous beach deposit to these, it became a repository of fossils, and was from its constitution better adapted to retain them. Mosely observed in the beach of Little Saba Island that there was being formed a reddish sandstone conglomerate rock, made up of the débris of the rock of the higher parts of the island cemented together by calcareous matter, derived from the corals and calcareous sand. And in this forming mass, which made a hard compact rock, there were embedded "plenty of the various corals from the beach, and large Turbo shells (*T. pica*) with their nacre quite fresh in lustre, and their bright greenish color unimpaired." Something similar is seen in the Chemung flagstones, and in the fossiliferous layers of this group of beds the organic remains are plentiful and well preserved. In the Catskill sandstones, which vary greatly in their texture, but generally are coarse and irregular in grain, we find the evidence of unfavorable conditions for fossil remains in the comminuted fish bones and scales, except where massiveness precludes such dislocation and fracture, as with the shoulder plates of large Antiarcha (*Bothriolepis taylorii*).

The fresh water bivalve, *Amnigenia catskillensis*, is found in the Chemung beds, in the shaly stratum known as the Oneonta sandstone, at Mt. Upton, Chenango Co., N. Y., and in the Catskill beds higher up, where it is embedded in sandstone. The state of fossilization in these two different positions is somewhat contrasted. The shells of this species in the magnesian slate, which has been a softer and less injurious matrix than the sandy layers of the Catskill girt, are well preserved, indicating a thinner and less corrugated shell than its representatives in the sandstone. The shell has here been kept entire, as in a replacement wherein we have the pseudomorph of the two valves in juxtaposition, the waving and somewhat confluent lines of growth conspicuous, and the thin, fragile expanded margin preserved, whereas in the sandstone the impressions of the surface are less clear and distinct, and the shell-body cannot be removed by itself, as in the type specimen from these softer and less sandy beds.

Fossils are well preserved in the slates, which, from their fine texture and mechanical homogeneity, take impressions easily. But in this group of deposits pressure has acted unfavorably in many instances, and the fossils have suffered distortion and compression. Many of our fossiliferous slates, as the Utica, Marcellus and Genessee, are dark-colored from carbonaceous admixtures, and the fossils in them partake of their color, which, in a measure, destroys their perfection and usefulness. Again, pyrite in many instances has been precipitated by organic reduction over the surfaces of fossils in these beds, and the fossils then appear coated or replaced by this yellow sulphide, by which they are made conspicuous upon a black background. The interesting sponges of the Utica Slate are by this means beautifully retained as a network of metallic threads and fronds, reticulating meshes of pale gold (*Cyathophycus subsphericus* and *C. reticulata*).

The limestone formations which represent the accreted deposits of foraminiferous ooze, shells, and the lime paste made by the solution of shells, contain fossils in great abundance, and yield excellent specimens. But specimens in individual perfection, such as are extracted full and free from their matrix, are mainly obtained from impure limestone rocks. The admixture of clay or sand differentiates as it were the matrix from its included fossils, and they seem less consolidated and blended with the surrounding rock, so that their outlines form boundaries of separation, and the fossils are picked out complete, quite disengaged from any adhering stone. Such beds as the Hudson River Slates, the Waldron beds of Indiana, the Hamilton layers in New York, the Lower Carboniferous shale at Crawfordsville, Indiana, are illustrations of a fossiliferous rock from which the fossils become detached, retaining their surface characters and a clean, hardened epidermis, from which every particle of rock can be separated. In siliceous limestones, like the Schoharie Grit, the Oriskany Sandstone, and the Calciferous beds along Lake Champlain, the fossils are revealed by weathering, whereby the limestone seems displaced by solution in surface waters, or slowly lifted from the contour of fossils by frost decrepitation, and the fossils remain as partial or entirely siliceous reliefs. Prof. Perkins, of Vermont, has found productive quarries of fossils under growing trees, where the vegetable acids have disintegrated the calcareous portions of these beds, and left the silicified fossils in complete relief or entirely free, as if shaken out from the enclosing envelopes of rock. In hard limestones this surface weathering often takes place, a sort of aerial development, by which the valves of shells, the spines and members of trilobites, the stems and plates of crinoids, slowly emerge and stand out on a rock, whose interior faces only reveal a poorly discerned outline of fossils, until they have undergone this atmospheric alteration. The fossils themselves appear to have resisted the attack of acid waters and frost from having a greater density, upon which these agents of change failed to act, or from having become silicified in the process of change. In many of these beds the fossils are colored by iron oxide, caused by weathering, from a protoxide to a sesquioxide, and so the contained remains of animals are changed from a blueish gray to a ferruginous yellow, and become more conspicuous. Fossil shells possessing a smooth, compact surface seem to have often escaped disintegration, while the surrounding matrix was removed, because they afforded no absorptive surfaces for the retention of the dissolving infiltrations of acid waters. It must also be borne in mind that the changes which limestone beds undergo from secondary crystallization, produced by the geognostic conditions of pressure, heating, etc., affect all their contents, and develop a crystalline structure in which the fossils become scarcely recognizable.

Invertebrate fossils occur as moulds, casts, or entire shells and bodies, according as they have left their impressions in the soft sediments amidst which they lay, or have been filled by the penetration of the ocean mud, so as to have produced a complete cast of their entire interior shape and markings; or, lastly, as they have been petrified throughout, and remain as they were deposited, retaining their exterior shell or integuments, and presenting when extracted a stone counterfeit of the original organism. Of course, for the most part, in such a process of petrifaction all interior structure is destroyed. But this is not universally the case, and many important interior appendages are sometimes preserved in exquisite perfection, or, at least, so far preserved as to afford instruction to the palæontologist. This preservation is determined by the nature and substance of these parts, and depends also upon the mineral conditions existing during the fossilization of the animal. Thus, the brachial appendages of *Orthis*, *Strophomena* and *Productus* are of such a soft and fleshy texture as to be unable to resist change long enough for their conversion into a mineral framework, although their impressions are found, whereas with *Spirifera*, *Terebratula* and *Atrypa* these delicate spirals and loops, upon which the breathing arms are supported in the chamber cavity of the shell, are preserved in a siliceous reproduction. Again, a sandy deposit will seldom permit the perfect preservation of fragile portions of the animal, nor induce that gradual replacement of its calcareous structure by silica, such as has evidently taken place in the corals of the Upper Helderberg limestone. An exception occurs in the Brachiopoda of the very sandy loosely coherent beds of the Oriskany sandstone at Cumberland, Maryland. In pocket-like cavites at this locality in the sandstone the molluscan remains are found beautifully preserved in silica, doubtless owing to the supersaturation of infiltrating waters with colloidal silica. The muscular bundles, the vascular markings of the circulating system, the punctate surface of the mantle in mollusca are, however, well retained in siliceous muds or sandy limestones, and surpass in usefulness similar indications in limestones, where incipient crystallization has destroyed these by knitting both shell and its contents into a crystalline unit.

Fossils are frequently removed by solution in carbonated waters, and possibly in waters carrying organic acids, as suggested by Dr. Julien, when "in porous masses of gravel, sand and clay" they become subject to saturation in such menstrua. Hilgard has shown the protective influence of an argillaceous matrix, for in the Tertiary deposits of the Southern States the shells were only partially destroyed in the clay layers, while calcareous concretions, made by the liberated lime from the dissolved fossils, were frequently in the more porous portions of the deposit. In the Palæzoic sandstones generally shells are less common than the impressions, moulds and casts, and a similar process of obliteration may have removed them also.

The replacement of invertebrate fossils by mineral pseudomorphs or substitution is a very interesting and important subject, and remains yet a peculiar method in the economy of nature. While it is true that silicification, or the replacement of organic structure by silica, is the most common and the most satisfactory form of this change, yet a number of other mineral species become transferred in organic bodies to the places occupied by the molecules of organic tissues, or of the carbonate of lime shells. In the Lower Silurian beds of the Galena limestone, in Wisconsin, fossils assume the substance of sulphide of lead (Galenite); and in Cornwall fragments of antlers, containing tin oxide, are found, wherein "the original structure seems to be almost entirely reproduced as cassiterite" (Phillips).

In the Coal Measures the fossil mollusca (*Solenomya, Macrocheilus Orthoceras Bellerophon*) are often found as earthy casts coated with a skin or shell of iron pyrite. Limonite, the hydrated sesquioxide of iron, reproduces the shells of *Atrypa, Beyrichia, Dalmania,* in the Clinton iron of the Upper Silurian, in Oneida Co., N. Y., while Malachite, Sphalerite, Sulphur, Barite, Celestite, Fluorite, Calamine, etc., in an imperfect way replace the shells or coverings of fossils, fill their interiors, and rarely take on the resemblance of their tissue and texture.

The silicification of fossils in its simplest expression is the substitution of the mineral quartz—silica—for the molecules of the shell of an organism, or for those of its hard or horny anatomy. The exact steps by which this alteration is effected are not clearly known, and of the many hypotheses offered to explain this phenomenon all may have some elements of truth. It was observed long ago by Von Buch that this silicification followed the organic structure.

It is certainly true that organic matter, if of some consistency, possesses some power of arresting silica, fixing it, as it were, by removing it from aqueous solutions. Le Conte suggests that at least in the case of wood an alkaline silicate in water is neutralized by the humic acid of the decomposing vegetation, by which the silica of the salt is precipitated in the pores of the wood, and the wood fibre, as humic acid, is removed as the silica assumes its position. This seems to imply too much incipient decomposition to be reconciled with the very perfect microscopic manner in which wood texture is replaced by an agate pseudomorph. Dr. Julien has laid great stress upon the important silicic compounds of vegetable or organic acids in producing colloidal silica replacements. This view seems to be that "during the decomposition of the sarcode of both animal and vegetable organisms, after death, gelatinous or colloid substances are generated, resembling *glairine,* which are soluble in sea water, which combine with silica, and may therefore convey and concentrate it, dissolving its particles disseminated through submarine sediments, and which may, in forms produced by gradual oxidation, act also as acid solvents of lime, oxides of iron and manganese." A similar explanation, though somewhat more simple, is, that in siliceous rocks, or in positions where calcareous fossils are exposed to siliceous waters, the terrestrial waters carrying silica, which may have entered into solution through its union with organic bodies, dissolve these fossils by their contained carbonic anhydride, and this assumption of a new burden diminishes their carrying power of other dissolved contents, and these latter are dropped at the exact moment the new solution is effected. Or, as carbonate of lime is taken up in solution silica is deposited. In the phenomenon of solutions and solvents this equilibrium of dissolved contents perhaps is not clearly proven, but seems in some cases probable.

(To be Continued.)

BIRD LIFE IN CENTRAL AMERICA.

BY DANIEL F. RANDOLPH.

A short time ago a friend of the writer was in Central America for the purpose of studying the country and its peculiar people. Ornithology is a hobby of his. Upon his return, I induced him to give me an account of his trip, which he did. The following is a transcript of my shorthand notes of his talk.

"I remember," he began, "that about the shores of the lagoon where I spent considerable time, there were great numbers of a handsome rail, which was very delicate eating, the flesh being milk white. It has a habit of skulking under the reeds and bushes on the shores during the day, and sometimes, when congregated in marshy places, makes a great noise by chattering in chorus. When shot, this bird goes through more contortions than any other bird I know of, not running away when wounded, but invariably tumbling on the ground, kicking and fluttering about in the most violent manner.

"A large red-breasted kingfisher is very common in all the lagoons and the lower part of the rivers; and blue and white garlings are seen on nearly all the shoals and creeks.

"I went along the sea-beach (by a little lagoon), among the mangroves, and secured three bittern and a few other water-birds. Some large snipe were to be seen there, active little sandpipers ran in great numbers along the hot sands, which enclosed the lagoon. I recall shooting in the savannahs a curious little goat-sucker; and I saw there a great tree covered with the large hanging nests of the yellow-tail. I also shot a species of night-heron, which the natives call "the carpenter:" it is one of the few birds they take the trouble to shoot for eating. All around the shores were large flocks of active fly-catchers, called the "wees bird," and a small falcon is often seen perched on the tall pine trees, or winging its rapid flight across the savannah in chase of the birds on which it preys.

One evening I paddled for some distance up a creek, to shoot something for supper. Here I met for the first time the beautiful heron called "Marana"; it was sitting quietly; the glossy, deep green leaves of a shrub forming a good background to its graceful form, and it appeared very tame. Evidently the bird creation of this remote creek had not often been disturbed by human beings. Further up it swarms with bitterns, boat-bills, darters, and other water-birds. As I paddled along, the bushy trees appeared to be alive with the odd-looking boat-bills, fluttering and flying out in all directions, seemingly convulsed with laughter.

"There are two kinds of curassow; the more common is white, with a black belly; the other, known as the Queen Curassow, is checked all over in much the same manner as the tiger-bittern. It is a handsome bird when seen in the woods, and erects its elegant crest gracefully as it utters its deep note. A pair of the pretty russet-brown "jacana," with lemon-colored wing feathers, kept flying in front of me as I proceeded up the creek, alighting from time to time on the floating grass which covered the water near the bank; owing to the immense length of their toes, they are able to support themselves on this. I also met with several mud-hens, which are much esteemed in this section for food by the creoles.

"Darters bred high up the creek; their downy young being generally seen in pairs in a nest formed of sticks, usually placed on a branch overhanging the water. They dropped out as I approached, diving and swimming about very actively. The darter seems to have much difficulty in keeping its balance when perched on trees, the feet being placed on the body considerably behind the point of equilibrium; this formation gives them great power of swimming under water, but makes them look awkward when out of that element. The neck is long and snake-like, and the beak curiously serrated, and admirably adapted for seizing fish beneath the surface. The eggs are bluish-white, with rather a chalky shell, small for the size of the bird, and considered good eating by the native creoles.

"My Woukee bittern, which I had taken from the nest when very young, gave me much amusement, especially on these long, lonely rides. When I had passed the bar, and found myself in the long tranquil swell of the open sea, he began to show symptoms of sea-sickness, being unable to sit upright, and twisting his long neck about in the most grotesque manner; at last he went below, under one of the thwarts.

"The brown pelican is commonly seen in small flocks upon the coast and lagoons, engaged in fishing, or, with a steady, powerful flight, pursuing its way to more favorable localities. Its mode of fishing is curious; the bird soars upon its broad wings to a considerable height, and then, as soon as a fish is seen, it descends, beak foremost, upon the water with a sudden wheeling evolution, and with great force; seldom, however, falling to secure its prey. At other times, the pelicans may be seen swimming like geese in the shallows, composedly spooning up the shoals of fry with their capacious beaks. The quantities of fish consumed by them must be enormous. Occasionally, a solitary individual may be visible, perched apparently in contemplative mood, upon a convenient mangrove bough. Another curious bird seen there is the boat-bill, called by the Indians, "Cooper."

"A little green heron is everywhere commonly seen by the waterside, and may be easily recognized, while yet unseen, by its loud cry of "tuk-tuk-tuk." The plumage of the cock yellow-tail is of a deep russet-brown, changing to black on the head and back, and the tail feathers are of a bright yellow; the top of the beak is coral-red, and the cheeks pale blue. They are sociable in their habits, living and breeding in flocks, and the branches of some favorite tree may often be seen covered with their long pendent nests. The difference in size between the cock and the hen is considerable, although the plumage is the same. They are probably attracted to these plantations by the quantity of ripe "panpa" and banana. Large flocks of a small kind are seen at certain seasons of the year. I shot several, but only secured one, the undergrowth of brush and cane being so matted together by creepers and bush-ropes.

"I sometimes saw among the pines very handsome hawks. The cry of the "bean-bean" is always to be heard on the savannahs. It has a curious knob of skin at the base of the neck. In color it is a sort of dull drab, shaded underneath with white. In habits, this bird resembles the magpie, hopping on the ground and amongst the branches of the trees, in the same springy manner. The hen-hawk is very common among the pine walks in the savannahs, and large green parrots fly chattering overhead, morning and evening. Their flight is exceedingly rapid and powerful. Trogons, pigeons, and other birds were to be seen in the thickets, and a red-headed woodpecker. However, there are few land-birds there. The white crane is very shy and will not admit of a near approach. Some large snipe, and rarely, a muscovy duck, would rise from the sedge."

UPON AN UNDESCRIBED SPECIES OF MEGASCOLIDES FROM THE UNITED STATES.

By Frank Smith.

Through the kindness of Mr. R. W. Doane of the Washington Agricultural College and School of Science at Pullman, Washington, I have recently received four specimens of a species of earthworm which I refer to the genus Megascolides. Mr. Doane writes me that this species is very abundant in that region of country and that their burrows are sometimes seen extending to a depth of over fifteen feet, in cuts for new roads. I am also informed that much larger specimens than those sent me, are often found.

The specimens were killed at a time when they were not at the height of sexual activity, and are not in perfect condition for histological study, hence I have prepared this preliminary description to be followed by a more extended account after the receipt of more material.

MEGASCOLIDES AMERICANUS n. sp.

Alcoholic specimens are 18–19 cm. in length and .6–.7 cm. in diameter. The number of somites in four specimens averages 226 with extremes of 240 and 190. The prostomium is incomplete. The clitellum is upon XIII | XXII and part of XXIII, and is incomplete ventrally. Median intersegmental genital papillae are present upon XIV | XV, XV | XVI and XVI | XVII, and paired intersegmental papillae upon XIX | XX and XX | XXI. The median papillae are wanting upon one specimen. Oviducal pores paired on XIV. Spermiducal pores paired on XVIII. Setae paired, those of the inner pairs being closer together than those of the outer ones and all in the ventral half of the worm. Penial setae having ornamented distal part are present in XVIII. There are dorsal pores posterior to the clitellum.

The septa VII | VIII to XII | XIII inclusive are much thickened and are connected with each other by longitudinal fibres, while the septum VI | VII is less thickened and that of V | VI is quite thin. The pharynx has a thick dorsal wall. A powerful gizzard is present in V. The oesophagus is enlarged in each of the somites XII | XIV where the walls are thick and vascular, while somites XI and XV have smaller enlargements. The intestine begins at XIX, but does not attain its greatest diameter until it reaches XXI. The nephridia are diffuse and begin as far forward as IV. They are numerous in each of the somites containing them and large in none. Each somite has numerous nephridiopores. The dorsal vessel is single. Swollen vascular arches or "hearts" are present in X–XIII, the posterior ones being the largest.

Testes and large conspicuous spermiducal funnels are present in X and XI, sperm sacs in XI and XII, ovaries in XIII and spermathecæ in VIII and IX. The sperm ducts of either side unite in XVI to form a common duct. The pair of spermiducal glands is in XVIII. They are tubular and much contorted and form flattened masses of considerable size. The terminal part forms a muscular duct which opens to the exterior laterad of the penial setæ, though in the same pore. The common sperm duct of either side unites with the spermiducal gland of its own side at the proximal part of the muscular duct.

Three species of earthworms quite closely allied to *M. americanus* have been described from the Pacific Coast region by Eisen and by Benham under the generic names Argilophilus and Plutellus, which have since been included by Beddard in the genus Megascolides; but the great majority of the nearly related worms are found in the Australian region. *M. americanus* differs from its North American relatives in the presence of numerous small nephridia in each somite instead of two large ones, in the extent of the clitellum and in several other characters.

Our knowledge of the proper classification of species included by different writers in the genera Megascolides, Cryptodrilus, Argilophilus and Plutellus is at present in a very unsatisfactory state, but the species described above is quite certainly a Megascolides. UNIV. OF ILLINOIS, FEB. 25, 1897.

BIRDS OF NEW GUINEA.

BY GEO. S. MEAD.

(*Continued from Vol. XXX, page 710.*)

Merops ornatus—the Variegated Bee-eater, according to Dr. Bennett the harbinger of spring in Australia, is abundant in New Guinea where it is sometimes seen in enormous flocks or succession of flocks, flying easily but not ceaselessly as if on migration bent. It is of a social disposition congregating together at all times like swallows and making nests in holes along river banks after the manner of the *Hirundinidæ.* Here in the sand excavations without soft nesting materials, five or six white eggs are laid. Although the bird is a pronounced bee-eater, its diet is not so limited as not to include other insects as well.

This species is of elegant form, slender and smooth-feathered. Light green, blue, black and saffron brown are the intermingled colors. From the fan-shaped tail project straight out two black quill shafts, an inch or more from the middle feathers, terminating in small spatulas. Herein lies the particular feature of this pretty bird. The long, sharp black bill with its curving line of beauty adds another element to make it as Mr. Wallace found years ago, "one of the most graceful and interesting objects a naturalist can see for the first time."

On the head plays an exquisite shade of brown extending down the neck. A similar tint lines the under side of the wings as well. The under parts are a vivid green approaching to light blue on the abdomen, but on the sides a spot or two of black may be traced. Blue of a decided depth covers the lower back, rump and throat. The wings above are of the same color as the under parts, becoming brown to dusky on the scapulars and secondaries. So varied is the coloration and so delicate the blending that the most elaborate description would not exhaust the catalogue of charms. Yet the bird after all is easily identified, besides being common in museums and of wide distribution. Moreover it is not of shy habits but may frequently be seen darting forth from some twig after the manner of flycatchers in pursuit of insects, but little disturbed by the notice its graceful motions have excited. Length about 7 inches.

An exceedingly abundant bird in New Guinea, Queensland and everywhere in Malaysia is the Glossy Starling—*Calornis metallica* (Temminck). D'Albertis speaks of these starlings as flying in myriads over his house on Yule Island in June, at that time probably pursuing their migratory instincts which, however, in these low latitudes mean little more than a trip across the Straits or over shallow seas. Mr. Moseley bears witness to the great numbers of this busy bird in his interesting Notes of a naturalist. He writes: "An immense tree with a tall stem free from branches, until at a great height it spread out into a wide and evenly-shaped crown, was full of the nests of the Metallic Starling. There must have been 300 or 400 nests in the tree; every available branch was full of them." The long slender body of this starling is entirely glossy black with purple, violet and green reflections. On the upper breast the overlaid plumes throw off a bronze or brownish tinge. The tail is spreading and graduated, the two middle feathers extending about an inch beyond the others. Length about 9 inches.

Speaking generally the Pittas or Ground Thrushes as they have been named, are of soft, brilliant and velvety plumage wherein the colors though contrasted, blend with most harmonious effect. In figure and shape they suggest the rail, having furthermore the short tail of that bird. In habits also they are not dissimilar, being shy and retiring, keeping within the gloom of the dense forest from whence their duplicated whistle sounds like a plaintive lament in the deep silence. They live chiefly upon insects and worms.

Pitta maxima or *gigas* found on the island of Gilolo, which Mr. Wallace rightly calls "one of the most beautiful birds of the East," is of large size being about 10 inches in length and standing to nearly the same height. This typical species is a glossy black above including the neck and throat. The under parts are velvety-white excepting the abdomen which is black but with the crissum and under tail coverts a fine scarlet, a characteristic mark of this family.

A shining blue beginning near the shoulder and banding the wings broadly, becoming less bright as it widens, adorns the sides. The specimen which is splendidly mounted and shown to great advantage in the Fairbank's Museum in St. Johnsbury, Vt., has a red feather in the upper tail coverts; whether this is anomalous may be questioned but I have also seen a white feather in one bird. The long strong legs of this giant of his tribe render it comparatively easy for him to make rapid progress through the intricacies of the pathless woods; the wings seem little used.

Mr. Wallace found the beautiful *Pitta concinna* at Lombock. It frequents the "dry plains densely covered with thickets, and carpeted with dead leaves" and was so shy that only by much strategy could Mr. Wallace get a shot at it. By imitating the peculiar whistling cry of two notes, he finally succeeded in shooting one of the birds that came near. They hop or run along the ground picking up insects, and on the slightest alarm take refuge in some thickets. The plumage is very soft and puffy. The upper body is a rich green, beneath a soft buff, very dark on the belly; around the vent and over the under tail-coverts lies the usual lovely crimson. The head is deep black divided by two narrow strips of blue and brown running over the crown as far as the nape. Bright blue appears in bands along the shoulders and near the tail. Throat, side face and neck are black as well as the under wing-coverts. A bunch of cloudy white lies near the black throat. A white spot or two marks some of the primaries. Bill black, feet brown. Length 6.5 inches.

Pitta strepitans is Australian but found in Southern New Guinea as well as on adjacent islands. In this species also the upper parts are dull green with black on the wings, and a white speculum, but dim blue plays over the upper wing-coverts and rump. The lower parts are mainly identical in color with those of *P. concinna.* In fact the chief variation apart from height and length, is in the coloration of the head. In the present species this is dark brown with black stripe intermediate. There is little significance in its name. Length 8.5 inches.

Pitta rufiventris from Gilolo and Batchian, is smaller than the preceding by at least an inch. Above green is the prevailing tint but of a paler cast. Blue as in the foregoing, the black being distributed in the same way also with the customary white speculum. Head and throat are rufous. The usual crimson somewhat dull, appears on the belly adjoining black. On the breast is a wide border of blue. There is little variation in the colors of the Pittas and but little difference in size or shape. The present bird is about 5 inches in length.

Pitta novæ-guineæ, notwithstanding the similarity between the Pittas generally is distinguished by somewhat more vivid colors than its congeners. Above it is a shining green, below a darker bluish-green. The head, entire neck and throat are black, the tail a dull green. The abdomen is black, giving space for the invariable crimson around the vent and upon the under tail-coverts. Much bright blue covers the upper wing-coverts, while the primaries have the customary white spot on their dark brown surface. Upon the rump this lovely blue is narrowed to the merest streak. A line of silvery white dividing the black throat from the oily-green breast is the specific mark. Length 6.5 inches.

Pitta macklotii is dull green above with blue and black on the wings and rump. Below the color is like that of the preceding species, though perhaps not quite so vivid. The cap is brown with bluish reflection. The throat below the chin is almost black. Total length 7 inches. This is about the average size of the Pittas and like his relations the *Macklotii* has the shy timid habits, retiring to the depths of thickets at the slightest alarm his whereabouts only to be suspected by the plaintive note uttered now and then.

Two or three species much resemble *Pitta novæguineæ*, the differences between them being but slight. In *P. rosenbergii* we find the colors somewhat more pronounced. Underneath along the sides is a length of purple gloss, while on the throat there is a greater extent of black. Length 7 inches. Habitat Mysore.

A local variety if not a distinct species belongs to Geelvink Bay and is dubbed *P. mafoorana* (Schlegel). Here also the colors are deeper, while the white spot does not appear at all. In all these instances the size is about the same.

The brighter green on the breast of the Mafoor Island Pitta fades into a greenish-blue on the sides. The larger upper tail-coverts are black, the lesser feathers green, identical with the coloration of the breast. *Coracopitta lugubris*, classed among the Pittidæ, is entirely black and of small size, reaching only the length of 5.6 inches. The tail of this solitary species of its kind is rather longer than among the true Pittas. Its legs are long while a peculiar bristling of the frontal feathers distinguishes it still further from its family.

Honey-eaters are well represented in New Guinea and its islands; in fact several islands of the Malay Archipelago contain a species, even a genus peculiar to themselves. They are never large birds, the average size being perhaps 8 inches in length, but they differ largely in respect to plumage, many of them being plain, others conspicuous by their brilliancy or some striking arrangement of color. Mr. H. O. Forbes has told us how lovely certain forms of *Myzomela* are, and one in particular—*M. annabellæ*—collected in Timor-Laut, embellishes as frontispiece, "A Naturalist's Wanderings."

Ptilotis filigera (Gould)—the Streaked Honey-Eater—from Northern Australia and Southeastern New Guinea is only imperfectly described by its name. The streaks are rather obscure markings, spots or shadings upon a portion of the generally brownish surface. Bare whitish spaces irregular in form surround the eyes. Just above the extended line of bare skin lies a patch of black. Above this the head is dark brown, the same color as that of the long tail on its upper surface. The neck, throat, breast and sides are a bluish-gray, lighter on the throat, The under parts are a soft fawn color, at times reddish, particularly on the flanks. The upper parts are a delicate brown, mottled and streaked along the bend of the wings. The bill is unusually long, dark and strong. Total length 8 inches.

The naturalist Moseley of the Challenger Expedition saw many of these little birds together with a kindred species *P. crysalis* at Cape York where they were busily employed in sucking the honey or eating the insects in the scarlet blossoms of the Erythrina tree. The last mentioned Honey-eater—*P. crysalis*—Mr. Guillemard collected on the shores of New Guinea.

Ptilotis albonotata—the White-spotted Honey-eater—a new species when Salvadori named it twenty years ago, is also a plain member of the large family of the *Meliphagidæ.* The white spots of the present species are small the largest appearing just behind the ear. On the bend of the wings is a line of white, while one or two more touches of white may be seen on the wing-coverts and middle of abdomen. The ground color above is yellowish-green, below buff. A distinct line of yellow marks the side of the face. Eye, bill and feet black or dusky. Total length 5 inches.

Ptilotis cinerea (Salvad.) the Gray Honey-eater is much larger than the preceding species measuring about 8 inches in length. Upper surface with tail is brown, gray of a somewhat dingy hue, marking the under body and head. The bill is noticeably strong and curved. Its color is black. The eyes are black and prominent. White quills are conspicuous on the wings and tail.

Another interesting member of the *Meliphagidæ* found by Senor D'Albertis in 1872 is *Melidectes torquatus*, so-called from the torque or partial circlet of white, around the neck. Like its race it has the curving bill, long tail, bare orbits and other peculiar marks which characterize the honey eaters. This species is fuscous above, tail and wings dark olivaceous, containing white spots on the black inserscapular feathers. Black or dark appears on the side face and throat, and again over the upper breast below a band of white somewhat longer. This is margined below by a narrow line of dull yellow about the same tint as that around the eyes and side neck. Under parts are mainly whitish, passing into yellowish near the vent and much marked with black spots along the sides. Feet, bill and iris are almost black. The sexes do not differ noticeably and are both about 8.5 inches in total length.

EDITOR'S TABLE.

—THE greater part of the American newspaper press needs a radical change of heart in the matter of reporting on subjects which come within the domain of biology It would pay the leading newspapers at least to have a scientific editor or referee to whom all paragraphs and articles on such subjects should be referred before publication. As the case now stands, it is not safe for any person to accept their statements in the department referred to, as truth. It is to be supposed that newspapers, with some conspicuous exceptions, prefer to publish the truth, and are fully impressed with the fact that their circulation depends largely on the trustworthiness of the statements which they make. The conspicuous announcement of false statements by newsboys may sell more copies on the street, but such publication can scarcely invite regular subscribers. We have, in previous numbers of THE NATURALIST, selected a few cases where foreign scientific journals have been misled by some of the customary misstatements and fictions of the American press, and we regretfully allege that the only safe course for scientific journals to pursue is to ignore everything that proceeds from this source, unless it appear over some responsible signature. This state of affairs is regrettable, since, in many respects, American journalism is the best in the world. It should maintain this position by securing accuracy in the direction referred to. Popular interest in biology was never greater than it is now, and a newspaper whose reports in this direction are reliable would certainly profit by it. This statement covers all cases, from the latest discoveries in bacteriology, paleontology, etc., down to descriptions of the habits of wild and domesticated animals. It would be better to publish nothing at all than the fictitious and inaccurate statements to which we are accustomed. These naturally diminish the respect in which the press is held, and reflect on our character as a people among the nations of the earth.

—THE proposition to consolidate the scientific work done by the United States Government into a single bureau has been recently made. Such schemes are pleasing to the eye, but their practical bearing is of far greater importance both to the Government and to science. The proposition has been opposed on good grounds, and such as should be, in our estimation, fatal to it. It is a good general rule not to "put all one's eggs into one basket," when there is anything precarious about the basket. Moreover, it is obvious that different departments must have their own scientific assistants, precisely as they have their own employees in other directions, if their work is to go on without continual interruption and loss. The experience of the departments and bureaus with the Government printing office has been cited in proof of the evil effects of such consolidation. The evil is becoming so apparent that it is now evident that the time has come for the work of that bureau to be restricted to congressional printing, and that for departmental printing each department shall have its own printing office. This is especially important as regards the productions of the Government scientific experts. Their results may lie in the hands of the Government printer for two or three years before publication, a state of affairs which should not exist in a progressive country. The progress of science is rapid, and our bureaus at Washington should be able to publish their results as soon as they are prepared for the press.

—A COLLECTION of living monkeys and snakes was recently seized by the New York Custom House authorities and sold by auction for the nonpayment of duty. It is strange that our tariff law has not yet been corrected so as to permit the importation of such objects free. They contribute to the educational material of the country both while living and after their death, and it would seem that the scientific work of the country should command sufficient respect to enable such a change to be made. Of course the Committee of Ways and Means has no especial desire to stimulate the growth of the native species of monkeys and snakes by levying duties on foreign species. We venture the assertion that the native production of these articles will not be seriously affected by acts of Congress.

RECENT LITERATURE.

Experimental Morphology.[1]—It is a pleasure to learn that the activity of the new German school of "Entwicklungsmechanik" has stimulated so happy a response on this side of the ocean as that in the book before us. The author's aim is to collect, in order, the observations and results thus far gained by the experimental method as applied to the understanding of "*why*" organisms develop as they do. Knowing, then, what has been attempted, we may more clearly advance with definite purpose and prospect of success.

The present volume treats of the effects of outside reagents upon *protoplasm*: three following volumes are promised, to treat in the same way, *growth*, *cell-division*, *differentiation*.

Such agents are somewhat arbitrarily divided into the following heads of chapters: chemical agents; varying moisture; density of the medium; molar agents; gravity; electricity; light; heat.

The chapter on chemical agents considers the change in motion, change in metabolism or the death of organisms acted upon by various poisons and other chemical bodies. The question of acclimatization to chemical agents is especially well treated and partly based upon the author's own work.

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[1] Experimental Morphology. Charles Benedict Davenport. Woodcut, pps. 280. The Macmillan Co., 66 Fifth Ave., New York. Price, $2.60.

Though essentially a compilation of facts, and hence not always free from the criticism of introducing statements upon doubtful authority —especially when one considers the author's great regard for accuracy and the comprehensiveness of knowledge necessary in experimental work —there is much that is original in the summarization at the end of chapters. Original work by the author is also included, and illustrated by some of the simple, but effective, diagrams as those showing the movements of amœbæ in light and in darkness.

The author's experiments upon amœba lead him to differ from Verworn and to decide that this lowly organized creature is strongly affected by light.

Such fundamental work is of the greatest interest to all biologists, whether devoted to botany or zoology, morphology or physiology, chemical or physical sides of life phenomena, and this chronicle of it should be of great interest to all who have escaped, or outgrown, that unfortunate myopia that too often limits the interests of the specialist. That the book is called a morphology is misleading as to its content: scientific physiology, without dependence upon medical instruction, would more fitly characterize it.

We trust the book will find the appreciation it so well deserves, both among specialists and among the intelligent laity.—E. A. A.

Oceanic Ichthyology.[2]—This work, issued as a special Bulletin in quarto form by the U. S. National Museum, is the joint production of Messrs. G. Brown Goode and Tarleton H. Bean. Its preparation has extended over a number of years. As first planned it was to include only the oceanic fishes on the east coast of North America. As new material was acquired by the Museum from collections made by the steamers Blake, Albatross and Fish Hawk, and from other dredgings of the U. S. Fish Commission, the work expanded to its present form, and it now stands as a "compendium and summary of existing klowledge in regard to Oceanic Ichthyology." The discussion takes the form of descriptions of all forms of pelagic and deep sea fishes found in the seas of the world, special prominence being given to those of the Atlantic Ocean.

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[2] Oceanic Ichthyology: A Treatise on Deep-Sea and Pelagic Fishes of the World, with an Atlas containing 417 Figures. By G. Brown Goode and Tarleton H. Bean. Special Bull. U. S. Natl. Mus., Washington, 1895.

As many of the specimens are unique, and much of the material fragmentary and hard to preserve, the descriptions have been made exceedingly full, so that a possible loss of material may not mean a total loss to science. Existing data concerning oceanic fishes have been carefully collected and incorporated with the authors' own observations in such a way as to be most serviceable for comparison and study by other naturalists.

A brief introduction deplores the meager knowledge of abyssal life, and points out that a more extended exploration of oceanic depths will reveal innumerable new forms.

A list of new genera and species shows 55 of the former represented by 153 of the latter.

The work comprises 553 pages of text and 123 plates, the latter issued separately as an atlas accompanying the text. It will be for many years the only text-book of the subject. A melancholy interest attaches to it as the last and most important contribution to science made by Dr. Goode. His death occurred almost immediately after its completion.

Fishes of North and Middle America.[3]—This work takes the form of a descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, north of the Isthmus of Panama. It includes, besides the fresh water forms, those of the off-shore banks and continental slopes of both oceans, the waters of the Gulf Stream, and also the Pelagic and abyssal forms that occur north of the equator. The present volume contains descriptions of 1,627 species belonging to 522 genera. These in turn are classified into 148 families, ranged under 28 orders. The authors recognize but 3 classes: Leptocardii, Marsipobranchii and Pisces, relegating to Pisces all fish-like vertebrates with paired fins. Sixteen new forms are described, and in the classification of these species the authors have found it necessary to create 1 new family, Steinegeriidæ, and 16 new genera. It has also been deemed advisable, for closer definition, to introduce 24 new subgenera.

We find in this work both conspicuous merits and demerits. Its greatest merit is the thoroughness of the work done in the discrimination of the species enumerated, and the appropriateness and conciseness of the descriptions. This is the principal labor involved in the preparation of the book, and it is this which constitutes its chief utility to the student. The excellent practice of furnishing analytical keys, which greatly facilitates determinations, is followed. It is a monument of labor which has extended over many years. The demerits count but little against the value of the work in this fundamental respect.

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[3] The Fishes of North and Middle America. By D. S. Jordan and B. W. Evermann. Bull. of the U. S. National Museum, No. 47. Pt. I, Washington, 1896.

However, we think the authors would have been wise to have restricted the scope of the book to the Medicolumbian region. It would have had then a definite application, giving it a more monographic character, and future monographs of the Neotrophical realm and its subregions would not overlap it. Next, we find the systematic defective in those points where it comes in contact with the extinct forms. Want of consideration of these necessarily destroys the perspective as to groups which have many extinct allies. We find that in endeavoring to do justice to Rafinesque they have gone to a greater extreme than the circumstances require. A good many species retain his names which can only be suppositiously identified by the method of catching fishes in his original localities. Such a method leads to no certain result, and does injustice to better work done by his successors. Finally, we object now and always to the preservation of words which are misspelled or false as to matter of fact as names, on the supposition that the law of priority requires it. When this all important law is made to apply to cases, which educated men never supposed possible, we have either an illustration of excessive idealism, or of Chinese imitation. Thus, the authors say (p. 330) respecting the name *Macrodon malabaricus*, given by Bloch to species confined to South America: "In the judgment of the present writers the law of priority, by which the first unpreoccupied name is right and all others wrong, a rule which tends to secure fixity of nomenclature, is more important than any rule leading toward truthfulness or purism in the name itself. On this ground *Macrodon malabaricus* does not mean a Macrodon from Malabar. It simply designates that Macrodon of which the earliest unpreoccupied binomial specific name is malabaricus. The errors in meaning in specific names deceive nobody and rarely cause inconvenience." We quote this paragraph in full, because it is an illustration of a legal plea in a bad cause. Its authors deeming truth of less importance than the letter of some law, do not hesitate to stretch the truth in defending their case. Malabaricus does mean of or from Malabar, and everybody is deceived by it except experts in the science, who have gotten their information from other sources. The habit of disregarding the truth is a bad one, especially in scientific methods. As to the cases of misspelling, which the authors have so religiously preserved, it may be regarded as certain that the educated American will be no more inclined to present himself with an unwashed face in good society than his European colleagues.

We hope that the second part of this work will soon be issued; but we understand that some delay in the publication is to be expected in the present condition of the Government printing office.—C.

Evolution or Creation.[4]—The author of this discussion calls it a "critical review" of the scientific and scriptural theories of the universe. The criticism loses its value when he states in the opening chapter, not only his bias towards, but his firm belief in the Biblical account of creation, "*literatum et spellatum.*" In stating the evolution theory he allows his imagination free play, unhampered by any conception of its real meaning or its bearing on the study of the problem of life as we find it developed on this planet.

Among the original hypotheses offered for the reader's consideration is one that dates the Mosaic week of creation somewhere about the end of the ice age. This, says the writer, "solves a score of scientific and exegetical difficulities that hitherto have been paraded as fatal to the credibility of the sacred Scriptures;" but it also leaves us completely at sea as to the author's views of the origin of the forms of life that preceded this so-called "Creation." Or, does he generously leave time, space and material for the evolutionist to demonstrate his theories?

Again, Mr. Townsend assumes a knowledge of the ways and means of the Creator, which is startling, even to a naturalist. His description of the genesis of man would appear to better advantage in the pages of the modern realistic novel than it does in a critical essay. Finally, we are gravely told that the "chief end of the creation" (not only of the world but) "of the universe, is so glorify *man* and enjoy him forever." We refer to this book not because it has any value, but, because in this country where biological education is only beginning to be general, a good many persons may suppose that it has.

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General Notes.

PETROGRAPHY.[1]

Augen-Gneiss and Intrusive Rocks at Bedford, N. Y.—Luquer and Riess[2] mention an augen-gneiss near Bedford, West Chester Co., N. Y., as covering an area of 15 square miles. The augen are in large part orthoclase or microclinic crystals that have been squeezed and flattened. They often occur in bands and are always elongated parallel to the foliation of the gneiss in which they lie. The rock shows abundant evidence of mashing, the large orthoclase constituting the augen being bent and the quartz grains associated with them being much granulated. The origin of the gneiss is ascribed to the dynamic metamorphism of an acid igneous rock. Diorite dykes and great veins and masses of pegmatite occur in the gneiss. The pegmatites are regarded as vein masses produced by segregation agencies.

The Basic End-member of the Augite-Syenite-Nepheline-Syenite Series.—In the Lujavr-Urt on the peninsula of Kola, Russia, occurs the feldspar free nepheline-pyroxene rock to which the name iolite has been given. Associated with it is an orthoclase bearing rock whose chemical composition is similar to that of the nepheline porphyry from Magnet Cave, Ark., and from Beemerville, N. Y., (sussexit of Brögger) and of borolanite from Borolan. An analysis of the supposed iolite shows it to differ from typical iolite in possessing only aegirine among its bisilicate components, and to be much poorer in CaO than the typical rock. The composition of iolite from Iiwaara is given in (I), while that of the Lujavr-Urt rock is shown in (II). The composition of the basic end-member of the quartz-augite-syenite nepheline-syenite series as calculated by Brögger is shown in (III). The author admits that the Lujavr-Urt rock may be regarded as an aegerine iolite, but he prefers to give it the distinctive name urtite. It is defined as a light colored, median grained rock composed of black

	TiO_2	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	P_2O_5	H_2O		Total
(I).	1.70	42.79	19.89	4.39	2.33	.41	11.76	1.87	1.67	9.31	1.70	.99	=	98.81
(II).		45.43	28.77	3.10	.40		1.86	.22	3.38	16.16			=	99.32
(III).		45.	25.	6.5			2.0	1.5	7.0	12.		1.00	=	100.00

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Amer. Geologist, XVIII, p. 239.

aegerine particles in a mass of nepheline and apatite, the proportional quantities of the three minerals present being about 12 per cent. of the first named mineral, 86 per cent. of nepheline and 2 per cent. of apatite. The orthoclase bearing porphyritic rock referred to above, is intermediate in composition between genuine iolite and urtite.[3]

The Anorthosites of the Rainy Lake Region.—Coleman[4] describes a number of additional occurrences of anorthosite near Bad Vermilion Lake, Ontario. The rock is in the main a white aggregate of bytownite or anorthite with the addition of a little chlorite or serpentine and an occasional augite grain. The plagioclase grains are often idiomorphic, and in some places the anorthosite passes into a porphyritic gabbro. Often the feldspars are enlarged by newly formed labrodorite, and in one section a bytownite crystal has been broken apart and its fragments cemented by the more acid plagioclase. The author dissents from Lawson's view that the anorthosite in this region represents the denuded core of an old volcano, which later extruded granite. He is inclined to regard the basic rock as much older than the acid one. Analysis:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	CO_2	Total	Sp. Gr.
46.24	29.85	1.30	2.12	tr	16.24	2.41	1.98	.18	1.03	= 101.35	2.85

Coleman suggests that all the rocks consisting almost exclusively of plagioclase shall be called plagioclasites, and the name of the plagioclase which is their principal constituent shall be prefixed to this. According to this scheme the name of the rock described above would be anorthite-plagioclasite.

Volcanic Rocks of the Fox Islands, Maine.—Reference has already been made in these notes to the existence of volcanic rocks in the islands of North Haven and Vinal Haven. Smith[5] has recently made a very careful examination of these rocks from both a geological and a petrographical standpoint. He finds the rocks on North Haven to consist of diabase schists and schistose tuffs, a series of acid volcanics and a small area of Niagara slates, limestones, etc. Vinal Haven is made up of acid volcanics, a series of fragmental schists and large masses of granitic and basic intrusive rocks in addition to acid volcanics like those found on the northern island. The greenstone schists of

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[3] Ramsay: Aft. u Geol. Fören i Stockh. Förh. 18, 1896, p. 459.

[4] Journal of Geology, IV, p. 907.

[5] The Geology of the Fox Islands, Maine. Pub. by the author. Skowhegan, Maine, 1896.

North Haven are squeezed normal and amygdaloidal diabases and diabase tuffs. They are probably pre-Niagara in age. The fragmental schists in Vinal Haven are also probably pre-Niagara. They comprise mainly quartzites and quartzitic slates. The basic volcanics are altered andesites, porphyritic diabases and andesites, and various pyroclastics. They were erupted in Niagara time. Following the basic lavas come the acid ones of Vinal Haven, consisting of various types of rhyolite, among the most interesting of which is a spherulitic rock containing spherulites of several different kinds. The commonest kind is composed of branching radiate fibers of feldspar imbedded in a granular aggregate of quartz. Flow breccias and tuffs occur intermingled with the massive rhyolites. The volcanic rocks are cut by dykes of quartz porphyry of felsite and of diabase. The large intrusions of the southern portion of Vinal Haven are granites, diabases (the black granite of the quarrymen) and diorites. The granites are typical biotitic phases containing some hornblende. Near the contact with the diabases they are porphyritic. The diabase of the southern end of the island is an olivine variety, while that in the eastern part is a transition phase between diabase and diorite. It contains brown hornblende and biotite in equal quantities with augite. Some phases have in addition a considerable quantity of quartz. The diorite and diabase are older than the granite, and both granite and basic rocks are believed to be much later than the volcanics. The only rocks of the two islands that show evidence of dynamic metamorphism are the old diabasic schists of North Haven. All however present many evidences of metasmatic alteration. Their structure remains intact, but their mineralogical composition is quite different from what it was originally. The basic lavas are saussuritzed and their ferro-magnesian constituents are chloritized. The glassy lavas are devitrified.

Petrographical News.—Pockels[6] argues that the magnetic polarity exhibited by many different kinds of rocks is due to conduction of electricity from the air. They are 'charged.'

Brauns[7] describes a micro-chemical test for nitrates. A drop of the solution suspected of containing a nitrate is treated with a drop of barium chloride and warmed in the water bath. Upon cooling octahedral crystals of barium nitrate will crystallize if nitrates were originally present.

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[6] Neues Jahrb. f. Min., etc., 1897, I, p. 66.

[7] Ib., p. 73.

Doelter[8] describes a number of syntheses of rock forming minerals and a series of experiments relating to the influence of mineralizers in the production of rock components. The descriptions close with remarks on the conclusions of petographic interest that may be deduced from the experiments.

The same author[9] declares as the result of microscopic and field studies that the granite of the Bachergebirge is an intrusive rock although it possesses gneissoid features. On maps of the district a granite porphyry is separated from the normal granite in coloring. This the author believes to be a mistake, as the two rocks are parts of the same magma.

The Koralps[10] are composed of mica-schists, interlaminated with amphibolites, eklogites, marbles and gneissic pegmatites. The mica-schists are overlain by phyllites and green schists. The pegmatites are of three kinds—a schistose aggregate of large tourmalines and feldspars, a granular aggregate of tourmaline, quartz and a little feldspar, and a massive quartz-rock containing a little tourmaline and feldspar. The amphibolites are in part garnetiferous.

GEOLOGY AND PALEONTOLOGY.

Rocks of the Antarctic Continent.—The rock specimens obtained by W. S. Bruce from floating ice and the stomach of Penguins in the Antarctic seas have been examined by Prof. Geikie, who makes the following report:

The larger specimens are all basalt, and contain a good deal of olivine. The small fragments are also mostly basalt, with some trachyte. All the specimens are what one finds upon the coasts of a region composed of igneous rocks. There was no trace of sedimentary or schistose rocks among the samples.

The marine deposits obtained by Mr. Bruce off the eastern extremity of Joinville Island were determined by John Murray and Robert Irvine. The specimens came from depths of 130 to 235 fathoms. They consist of fragments of polyzoa, basaltic gravel, basaltic and quartz sand, and blue mud. The latter contains mineral particles, which indicate that on the adjoining land will be found true continental rocks. (Geog. Journ., 1896.)

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[8] Neues Jahrb. f. Min., etc., 1897, I, p. 1.

[9] Mitth. des Naturw. v. f. Steiermark, 1894.

[10] Doelter, Ib., 1895.

Queries on Rock Differentiation.—The theory of the differentiation of rock magmas, now so generally held by lithologists, is questioned by Mr. G. F. Becker. The following is an abstract of his discussion of the subject:

"All known processes by which the segregation or differentiation of a fluid magma could take place involve molecular flow. This is demonstrably an excessively slow process, excepting for distances not exceeding a few centimeters. Soret's method, even if it were not too slow, seems inapplicable, because it involves a temperature unaccountably decreasing with depth. The normal variation of temperature, an increase with distance from the surface, would be fatal to such segregation. The least objectionable method of segregation would be the separation of a magma into immiscible fractions; but this seems to involve a superheated, very fluid magma, while the law of fusion and the distribution of phenocrysts in rocks indicate that magmas prior to eruption are not superheated to any considerable extent, and are very viscous.

"The homogeneity of vast subterranean masses called for by the hypothesis of differentiation is unproved and improbable. The differences between well-defined rock types are more probably due to original and persistent heterogeneity in the composition of the globe. Hypogeal fusion and eruption tend rather to mingling than to segregation, and transitional rock varieties are not improbably mere fortuitous mixtures of the diverse primitive, relatively small masses of which the lithoid shell of the earth was built up." (Amer. Journ. Sci., 1896.)

The Coal Measures of Arkansas.—The descriptions of marine fossils from the Coal Measures of Arkansas, by Mr. J. P. Smith, are of especial interest, since they afford means of correlating strata of different regions, and also because marine fossils are usually rare in the Coal Measures. Among the important finds are two species of Pronorites, to which the writer refers as follows:

"The finding of Pronorites in Arkansas is of great importance, since it is the ancestor of a form, Medlicottia, which, though unknown in Arkansas, has been found at no great distance, in the Texas Permian. These occurrences help to prove the continuity of life from the Carboniferous into the Permian, and to show that the same conditions existed here as in the Artinsk region of the Ural Mountains, where the Carboniferous beds contain the goniatites, out of which most of the Permian ammonites were developed."

The relations of the strata in which these fossils were found to the Coal Measures in both the Old World and the New is shown in a correlation table accompanying the descriptions. (Proceeds. Amer. Philos. Soc., XXXV, 1896.)

The Lead and Zinc of Iowa.—In a report on the Lead and Zinc Deposits of Iowa, Mr. A. G. Leonard states that these ores occur in crevices in the Galena limestone in the northeastern part of the State, in what is known as the driftless area. Contrary to the general rule, that ore deposits are found with areas of disturbance in the earth's crust, the ore deposits of the upper Mississippi are found in strata which show no evidences of having been subjected to dynamic forces. The author accepts Chamberlain's theory as to the localization of these ores, viz., currents of the old Silurian sea. The oceanic waters impregnated with metallic salts derived from the leaching of the adjacent lands were borne by currents to areas where there was an abundance of organic life, and here the metals would be extracted and thrown down along with the sediments. As to the filling of the crevices, he adopts the lateral secretion theory, as being more in accord with his observations. (Iowa Geol. Surv., Vol. VI, 1896.)

The Eruptive History of the Yellowstone Park.—Mr. Hague collates a series of facts to demonstrate that the pouring out of igneous rocks in the Yellowstone Park began with the post-Laramie uplift, or closely followed it, the outflow continuing with greater or less energy throughout Tertiary time. The great value of paleobotany as an aid in determining the age of geological formations is illustrated in this region. At least five distinct and important geological periods are defined by their fossil flora, of which four are exposed in the park within a few miles of each other.

The following table shows the relationships between the different geological formations and the floras which characterize them:

Formations.	Flora.	Age.
Basic breccia	Lamar	Upper Miocene.
Intermediate breccias	Intermediate Flora	Lower Miocene.
Acid breccia	Fort Union	Eocene.
Agglomerates, Waterlain	Livingstone	Cretaceous.
Igneous Material.		
Sandstone	Laramie	Cretaceous.

(Amer. Journ. Science, 1896.)

The Atlantic Coast Eocene.—A study of the Middle Atlantic Coast Plain, with a view to its correlation with the Gulf region, by Wm. B. Clark, has recently been published by the U. S. Geol. Surv. The author reviews critically the characteristics of the Eocene strata as developed in the States of Delaware, Maryland and Virginia. While the geological and stratigraphical data are examined with care, it is the paleontological record to which is given the most attention. Accordingly the report includes an exhaustive study of the fauna of the region under discussion, together with a critical review of the species described by previous authors, as well as the description of a number of new forms.

Briefly stated, the Eocene deposits of the Middle Slope are typically glauconitic, with an average thickness somewhat in excess of 200 feet. The organic remains consist largely of shells of mollusks, whose appearance indicates that they were but slightly disturbed prior to their burial in the sediments in which they are now found.

The fact that the strata are so largely made up of secondary materials shows that the position of accumulation was in the vicinity of a coast reached by no large rivers bearing sediment, while also, for the most part, sufficiently removed from the coast-line to be unaffected by shore conditions. These deposits, also, were very slowly accumulated. These conditions were markedly different from those prevailing in the Gulf region. There numerous large rivers discharged great quantities of material, so that the strata of the Middle Atlantic Slope must be represented in the Gulf by deposits many times their thickness.

After considering all the facts, the writer is decidedly of the opinion, "that the deposits under discussion represent the greater portion of the Eocene series of the Gulf, its upper members excepted. Compared with the section originally described by Prof. E. A. Smith, in the Alabama area, it undoubtedly comprises all or the major part of the Lignitic, Buhrstone and Claiborne, and, perhaps, also portions of higher horizons; but, regarding this latter point the necessary paleontological evidence is wanting. The reference does not, however, necessarily involve the assumption that the basal beds of the Potomac section are the exact equivalents of the Lignitic, since deposition may have commenced somewhat earlier than in the other, although the difference in time was not great." (Bull. U. S. Geol. Surv., No. 141, 1896.)

Glacio-Marine Beds of Europe.—Among the important observations made by Col. H. W. Fielden during his recent explorations of Arctic Europe was one concerning the deposition of glacio-marine beds. Owing to the rapid elevation of the Spitzbergen region, it is possible to examine in detail the immense deposits originally formed in front of glaciers. These deposits now lie between the present shore-line and the edge of the glacier of to-day. The author instances a formation of this nature to be found at the head of Green Harbor, one of the minor indentations on the southern side of Ice Fiord, and describes it as follows:

"The front of the glacier that now occupies the valley is about a mile distant from the present shore-line. Fronting this glacier, the terminal face of which is about 50 feet in height, and extending for 1½ miles in length, is a range of some 50 to 70 feet high and ½ mile in width. These hills have undergone much subærial erosion, and channels have been cut in them by the numerous streams issuing from under the glacier. Following up one of these water courses, which average from 25 to 50 yards across, with a very level bottom, we find sections of mud and clay rising like walls on either side to a height of 50 to 60 feet. These beds contain numerous stones, but do not show any signs of stratification; in them I found shells of *Mya truncata.* That these beds are of submarine formation is confirmed by the existence of raised beaches in neighboring fiords and along the adjacent line of coast, at a higher level than the beds I am now describing. Between the present face of the glacier and the perpendicular wall of the mud-hills runs a sort of ditch, dry moat, or open space, some 30 yards in width, along the entire front of the glacier. The bottom of this ditch is thickly strewn with morainic débris, composed of rounded ice-worn stones, many being deeply grooved, scarred and scratched. Through this slope of rocks and stones glacier streams were pouring forth."

The author suggests, that since this process of rock accumulation probably went on when the glacier projected in the sea, that during the emergence period there would come a time when the bay-ice would freeze deep enough to incorporate the boulders of the moraine, and quantities of ice-scratched and ice-polished stones would be floated away on the breaking up of the bay-ice in the spring. This would explain the occurrence of the vast number of scratched erratics found in the glacio-marine beds of Kolgnev Island.

Observations made in Greenland show that in the neighborhood of glaciers discharging into the sea the water is charged with sediment, and the ship's anchor when lifted in front of some of these glaciers brings up a heavy weight of unctuous mud, thus confirming the theory that "water issuing from under a glacier in Polar regions, and discharging from under the ice into the sea, can lay down glacio marine beds in the ocean," and the occurrence of ice-scratched stones throughout these beds is also accounted for. (Quart. Journ. Geol. Soc., Pt. 4, 1896.)

Geological News.—Mr. R. P. Whitfield notes a new genus of Phyllocaridæ from the Lower Helderberg, near Waubeka, Wisconsin. He proposes the name *Entomocaris*, from the resemblance of the carapace to that of an ostracode entomostracan. (Bull. Amer. Mus. Nat. Hist., 1896.)

A recent paper by Mr. F. A. Bather gives a morphological description of *Uintacrinus socialis*, and discusses the relations of the genus to certain Paleozoic crinoids. He shows that Uintacrinus cannot be related either to the Camerata, as Jaekel has supposed, or to the Ichthyocrinidæ, as maintained by Von Zittel, Neumayer, and others. By a process of comparison and elimination he finally determines that of all the known genera Dadocrinus is probably the most nearly related to the ancestor of Uintacrinus. (Proceeds. London Zool. Soc. (1895) 1896.)

A new genus of fossil birds is reported from the Pliocene of South Australia. The specimens consisting of portions of a dozen birds were found at lake Collabonna. They are described by Messrs. Stirling and Lietz under the name *Genyornis newtonii*. The generic name refers to the conspicuous feature afforded by the relatively large size of the lower mandible. The femur indicates a gigantic bird, its dimensions surpassing those of *Pachyornis elephantopus*, and nearly equalling those of *Dinornis maximus*. (Trans. Roy. Soc. South Austral., XX, 1896.)

According to Lydekker, the affinities of the so-called extinct Giant Dormouse (*Myoxus melitensis*) are not with the Myoxidæ, but with the Sciuromorpha. He suggests for it the new generic title *Leithia*, defining the genus, and figures its type of dentition. (Proceeds. Zool. Soc. London, 1895.)

BOTANY.[1]

Long Stolons of Phragmites.—Several years ago some remarkable specimens of a running grass were brought to me from the islands of the Platte River in Central Nebraska. Although quite puzzling at first they were soon found to belong to the common Reed Grass (*Phragmites phragmites* [L.] Karsten). Some of the specimens were of astonishing length, one measuring a little more than seventeen meters! At every joint fibrous roots were sent out and from many of the joints there grew leafy stems, a meter or more in height. A careful investigation showed that these long trailing stems were at first underground stems, and that after growing under the surface for some distance, the sand had been removed by the shifting currents of water, thus exposing the stems to the air. These exposed stems, thereafter grew as stolons running over the surface as described above. I am told that occasionally these running stems almost entirely cover portions of the islands, and the broad sand-bars along the margins of the river.—CHARLES E. BESSEY.

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[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

Barnes and Heald's Keys to Mosses.—Botanists will welcome the new, revised and extended "Analytic Keys to the Genera and Species of North American Mosses" which appeared in January of the present year, as one of the Bulletins of the University of Wisconsin. The thick pamphlet includes about 220 octavo pages, eight of which are devoted to a brief introduction, thirteen to the key to the genera, eighty-one to the key to the species, and one hundred and eighteen to descriptions of the species and varieties which have been published since the issue of Lesquereux and James's Manual in 1884. Under the latter there are enumerated, six hundred and three forms, many of whose descriptions are here available for the first time to most American botanists. The work can not help but stimulate the collection and study of mosses, in the botanical departments of our colleges and universities, and it should do somewhat to excite the interest of pupils in the high schools, academies and other secondary schools in which pupils pursue elementary botany. There is no good reason why students who are admitted to the Freshman classes of our colleges and universities should be wholly ignorant of the structure and relationship of the mosses, and this book (which may be obtained for one dollar) will be helpful to all teachers and pupils who wish to make an effort to know something of these interesting plants.—CHARLES E. BESSEY.

VEGETABLE PHYSIOLOGY.

What is Leuconostoc mesenteroides?—This organism was first described by Cienkowsky in 1878, under the name of *Ascococcus mesenteroides.* He obtained his material from beet sugar vats, and described the organism as consisting either of rods or coccus forms. The gelatinous clumpy masses had been familiar to sugar makers for a long time, and often multiplied enormously in the beet juice, forming cart-loads of the so-called "frog spawn." In 1878 van Tieghem also studied the organism (*Ann. d. Sci. Nat. Bot.* Sé. 6. t. 7. p. 180), considered it to be closely related to Nostoc, and renamed it *Leuconostoc mesenteroides.* His observations contradicted those of Cienkowski in several important particulars. He found no rod-shaped bodies, but only a coccus, which, in exhausted material converted some of its members into spores, particular cells of the chain enlarging perceptibly, becoming more refractive, and taking on a thicker wall. His first material was discovered in the laboratory by accident in macerations of dates and carrots. Subsequently the organism thus found was compared with that from the beet sugar vats and found to be identical. In 1892, Liesenberg and Zopf published two papers which threw a flood of light on the subject (Zopf: Beiträge I and II). They first obtained the organism from the Spree River water, below certain breweries, starch factories, etc. This form was subsequently compared with material from a beet sugar factory in Germany, and found to be identical. Their experiments covered a period of two years, and were carried along in two parallel series (1) with the European organism and (2) with material obtained from cane sugar vats in Java. The Javan and European form proved to be morphologically identical, and there were only a few very slight physiological differences. The organism as it comes from the vats is always contaminated with other bacteria, which stick to the gelatinous sheath. Pure cultures were therefore obtained with some difficulty, and only after it was discovered that the contaminating bacteria could be destroyed by heat without injury to the Leuconostoc. Poured plates made after exposing the finely rubbed mass in fluid to 75° C. for 15 minutes invariably yielded an abundance of pure colonies. The organism is plainly dimorphic. In solid or fluid nutrient media containing grape or cane sugar it multiplied in the ordinary gelatinous or cartilaginous, lumpy, frog spawn form. In similar media destitute of grape or cane sugar it grew in an entirely different form, i. e., as an ordinary, thin-walled Streptococcus. The two forms were so remarkably different both macroscopically and microscopically that the Streptococcus form was at first supposed to be some intruding organism; but repeated transfers of the two forms back and forth always gave the same results, i. e., the frog spawn form on nutrient media containing sugar, and the nude form on the same media when free from cane or grape sugar. The change from the nude to the covered form was followed in hanging drop cultures, and occurred in 12 to 24 hours. In nature the organism probably most often occurs in a form quite unlike that found in the sugar vats. Transitions to the nude form were also observed in old sugar cultures, which had become acid from the growth of the organism. Moreover, the tough, shiny, elastic cartilaginous form developed on sugar media during the first week or two of growth was always observed to break down later on, becoming first flabby and then juicy soft. The nude form cannot be distinguished from Streptococcus; and both Migula and Lehmann and Neumann now write *Streptococcus mesenteroides.* Steamed potato proved excellent for the cultivation of the nude form. The cartilaginous form grew well on carrot. The organism is able to ferment the following carbohydrates with the formation of an acid: grape sugar, cane sugar, milk sugar, maltose, and dextrin. Glycerin is not fermented. It can produce its enormously thick envelope only from grape sugar or cane sugar after it has inverted it. The sheath is composed of a gum-like substance called dextran by Scheibler. It is incorrect to speak of a "dextran fermentation." There is no such thing. The sugars are fermented with production of an acid, but the dextran is as much a product of growth as cellulose. The acid formed from the grape and cane sugar (and presumably from the lactose and maltose) is lactic. This was identified by its calcium salt and zinc salt. Under ordinary conditions no appreciable gas was formed from any of these carbohydrates; but in the presence of calcium chlorid, or in the absence of oxygen, bubbles were given off (apparently CO_2). Calcium chlorid when added in 3–5 per cent. portions to properly prepared nutrient sugar solutions greatly favors the formation of dextran. Growth in such cases was very rapid, 101.5 grams of the Leuconostoc in one instance being developed out of 50 grams of cane sugar in four days. The organism is aerobic and also facultative anaerobic. It can invert cane sugar, but produces no peptonizing or diastatic ferments, and has no effect on cellulose. It is able to take both its N. and C. from peptone or from asparagin, but not from ammonium tartrate. In a 5 per cent. cane sugar solution containing the requisite inorganic salts no growth was obtained on adding ammonium tartrate, ammonium nitrate, or potassium nitrate, which would tend to show that it cannot take N. from these salts. The thermal relations are peculiar. Although a great variety of cultures in all stages of growth were examined for spores, nothing of the sort was found, and it is believed that no spores exist, certainly none of the sort described by van Tieghem. The organism is nevertheless very resistent to heat, even in the nude form. It grows at 9° to 11° C., but forms no acid. At 14° to 15° there is plain growth in 4 to 5 days with production of acid. 'Grows well at

21° to 23° C. Optimum 30° to 35° C. for the European form, and 30° to 37° C. for the Javan form. The maximum temperature for growth is 40° to 43° C. It cannot grow in juice kept at 43° C., but is not killed. The thermal death point of the frog spawn form is between 87° and 88° C. (five minutes exposure), and of the nude form only a little lower, i. e., between 83½° and 86½° C. It is thought that possibly the thick sheath may have a protective use, as dried and stone-hard specimens brought from Java were found to be alive at the end of 3½ years. A good contrast stain for the frog spawn form is dahlia followed by corallin.—Erwin F. Smith.

A New Disease of Tobacco Caused by Phytophthora nicotianæ.—This disease, described by Dr. J. v. Breda de Haan,[1] is most destructive to the seedlings while yet in the seed bed, but attacks older plants as well, extending its ravages under favorable conditions even to the curing barns. In this paper, published early in 1896, the author presents a very satisfactory account of the disease, and precedes the account by a general description of the location of the tobacco fields in the Dutch East Indies. The relations of soil and climate to the parasite are fully pointed out, as are the methods of culture both of the seedlings and of the mature plant.

The disease is, so far as he has been able to determine, confined to the Dutch East Indies. It has probably caused some damage for many years, but was first generally recognized in 1889. In 1893 it was very destructive, owing to the wetness of the season.

The hyphæ of P. nicotianæ enter the leaf by the stomata, and ramify principally in the intercellular spaces. They also pass through the cells, and sometimes fill them with a net-work of hyphæ.

Usually only the haustoria enter the cells. The haustoria are simple unbranched hyphæ, which end freely in the cell.

The mycelium is normally unicellular; but when it is torn, or when the protoplasm is contracted, on account of unfavorable external conditions, the cell contents are separated from the empty part of the mycelium by thin cross walls.

The contents are granular, with scarcely any oil drops, and stain readily with an aniline blue. The hyphæ are about 5 mic. mill. thick, and when free to do so grow long and scarcely branched. Sometimes they may be seen reaching from one seedling to another, looking like delicate threads.

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[1] (De. Bibitziekte in de Deli-Tabak veroorzacht door Phytophthora nicotianæ. *Mededeelingen uit's Lands Plantentuin,* Number XV, 1896.)

The spread of the disease is greatly facilitated by the method of growing the seedlings ("bibit"). Several beds are prepared one after another, so that the series contains seedlings of all ages. These are separated by narrow walks, and are themselves narrow enough to permit the coolie to reach all parts of the bed.

In his search for worms or insects the coolie touches diseased and healthy plants, transferring the fungus from one to the other. He also carries the germs about on his clothing or tools and watering pot. The mature plants often show the disease on the tips of the leaves, where persons have brushed against them in passing. The parasite also spreads over the ground, growing from bed to bed across the narrow walks.

In one case only was the agency of wind as good as proven. In this case the center of infection lay to the windward of the later attacked beds, and the beds not in the path of the wind were not attacked.

Conidia are produced in abundance. The conidiophores usually pass out through the stomata, but may push up through the epidermis. At the end a pear-shaped (ob-pyriform as shown in the figures) conidium, 36 x 25 mic. mil. in size is formed, and when ripe is cut off from the conidiophore by a cross wall.

A second conidium is sometimes developed from the side of the first one, and remains connected to it by a short hypha. The contents of the first conidium pass into the second one, in which the swarm spores are developed. The development of the swarm spores requires about 20–30 minutes, at the end of which time the "slime plug" at the apex of the conidium dissolves and they emerge. The number observed in a conidium varied from 10 to 15.

Each swarm spore has one flagellum, and may have another, but of this the author is uncertain. The swarm spores may give rise to secondary conidia. Two cases were observed, but in neither case was the development of swarm spores seen. In the first case the conidium was developed three days after the liberation of the swarm spore in a hanging drop water culture. It remained in the same condition a few days and then perished. In the second case the conidium was found open at the end of four days and the contents gone. No mention is made of swarm spores in the surrounding medium.

Sexual reproduction takes place by means of oogonia and antheridia. The antheridium may arise from the same hypha as that on which the oogonium is borne, or on a different one. The contents of the antheridium are emptied into the oogonium, after which the oospore forms a wall about itself. The process is in all respects the same as that in other

Peronosporaceæ, except that so far as could be ascertained all the contents of the antheridium pass over into the oogonium. This is a departure from the usual course for Phytophthora, in which, according to de Bary (1881) and also Strasburger (Lehrbuch der Botanik, 1894) only a part of the contents pass over.

Phytophthora nicotianæ has the omnivorous habit of P. cactorum C. & L. (P. omnivora de Bary), attacking species of Amaranthus and seedlings of Androng as well as tobacco. The habit of the conidiophores also resembles this species especially in the absence of the swellings under the conidium so characteristic of P. infestans. It differs, however, from P. omnivora in the size of the conidia, which are 50, 60 or 90 mic. mil. long by 35 or 40 mic. mil. wide in P. omnivora, and only 36 x 25 in P. nicotianæ. The size of the conidia brings it closer to P. phaseoli Thaxter in which they are 35–50 x 20–25 mic. mil. in size. The biological identity not having been established the author decides to call the present species P. nicotianæ sp. nov.

The first symptom of the disease is a wrinkling of the edge of the leaf accompanied by wilting, and, if the petiole is attacked, drooping of the leaf. When the attack is severe the seedlings soon change to a dark green slimy mass, covering the surface of the bed. The appearance presented is as though boiling water had been thrown over the bed. On older seedlings and mature plants the disease appears in spots on the leaves. These are at first not well defined, and have a dark center with indefinite circumference ; later, the center dries up and becomes translucent, or if on older leaves, brown, and a dark green border separates it from the healthy portions of the leaves. The disease also attacks the seedlings near the ground, causing damp off. Mature plants sometimes show the disease in this form ; but it is nearly always due to using diseased seedlings for transplanting.

The account of the artificial cultures is unfortunately lacking in definiteness.

The author made cultures in various strengths of cane sugar solution, 5, 10 and 15 per cent., in prune juice, in a decoction of tobacco ashes in water, on sterilized potato slices, on agar-agar mixed with peptone-gelatine and tobacco water, and on slices of banana. All failed, except those in 5 per cent. sugar water and on sterilized potato. These gave fairly good results for a few days, but subsequently also died. The author does not state whether his sugar solution contained any nitrogenous matter, nor whether distilled water was used in making it, but leaves it to be inferred that such was not the case.

Mycelium forming oogonia was brought into a 5 per cent. solution of cane sugar, in which it grew for a few days and produced many fructifications. After six days it remained stationary. The cultures in 15 per cent. sugar solution were poor, and developed what seemed to be a yeast form. Conidia-forming mycelium was also grown in a 5 per cent. sugar solution, and produced for a few days many conidia, the swarm spores of which germinated with long germ tubes.

Agar-agar was mixed with peptone gelatin and leaf decoction (tobacco presumably) in "various ways," but without success. Author does not give the different proportions.

Some mycelium was put on the surface of sterilized potato slices, on which it grew fairly well. The tissue penetrated by the fungus turned red, the starch disappeared, and the cell walls became mucilaginous. The fungus grew intra-cellular, but died after a few days. This culture succeeded best when kept in the dark. The author does not state whether the potato was sterilized by steam or by chemicals.

The relations of the parasite to drying and to darkness were studied. Darkness was found to be generally advantageous to it.

The mycelium and conidia are unable to withstand the least drying. The oospores, however, are more resistant, but succumb to constant drying for 14 days, or when the leaves containing them were subjected to a hot sun bath for five hours on two successive days.

Extensive experiments were conducted in order to combat the disease. It was found that by the free admission of light and air to the seed beds, together with liberal spraying with Bordeaux mixture every five days, or after heavy rains and during damp weather, the fungus could be held in check. Where such measures were taken the tobacco beds were comparatively free from the disease.—A. J. PIETERS.

ZOOLOGY.

On the Occurrence of Filaroides mustelarum van Ben. in American Skunks.—Through the kindness of Mr. Gerrit S. Miller, Jr., I have recently had the opportunity of examining a skull of the common skunk (*Mephitis mephitica*) from North Bay, Ontario, the frontal bones of which each exhibited, close to the sagittal plane, a prominent swelling over which the bony tissue was so attenuated as to be easily crushed by the finger. The specimen was still in the flesh, and was preserved in formalin. Mr. Miller tells me that he finds these frontal enlargements in a large percentage of the skulls of both *Mephitis* and *Spilogale* from all localities. Merriam (Revision of the Genus Spilogale, N. A. Fauna, No. 4, p. 3, 1890) speaks of "large asymmetrical postorbital swellings resulting from the presence, in the frontal sinuses, of a worm-like endoparasitic arachnid of the genus *Pentastoma*," and on p. 4 of the same work, refers to "the large swellings produced by the worm-like parasite (*Pentastoma* or *Linguatula*) which infests the frontal sinuses of more than half the skulls examined." Bangs, in a Review of the Weasels of Eastern North America (Proc. Biol. Soc. Washington, Vol. X, p. 1, 1896) speaks of "the parasite that attacks the frontal sinuses of these animals as well as those of their relatives the skunks, mink, and otter." *Putorius noveboracensis* he says "suffers so much that it is hard to get perfect skulls." See also the figures of skulls in Merriam's Synopsis of the Weasels of North America (N. A. Fauna, No. 11, 1896).

The swellings in the frontal bones of the specimen of *Mephitis* submitted to me are caused by a nematode worm which in every particular agrees with *Filaroides mustelarum* van Beneden (Mém. s. l. Vers Intestinaux, p. 267, 1861), and I have no hesitancy in ascribing it to that species. Each of the swellings contained a nest of at least fifteen to twenty of the worms. The parasite is common in Europe, occurring in the air-passages of several species of Martins and Weasels. It has been described and figured in the frontal sinuses of *Mustela* by Weijenbergh (Arch. Néerlandaises, Tom. III, p. 428, 1868), and von Linstow (Arch. Naturg, Jahrg. 39, Bd. I, p. 300, 1873) has described it from the ethmoid and frontal bones of *Mustela* and *Putorius*. The parasite is always, directly or indirectly, connected with the respiratory system.

The object of this note is to call attention of the occurrence of *Filaroides mustelarum* in America, and to show that, without doubt, the swellings so common in the skulls of American skunks are caused by the presence of this nematode in the frontal sinuses; and that the prevalent frontal enlargements of other American Mustelidæ are probably due to the same parasite.—W. McM. Woodworth.

Museum of Comparative Zöology,
Cambridge, Mass., Jan. 21, 1897.

A Peculiar Appendage on the Thelycum of Penæus.[1]—A short preliminary note by Dr. Kishinouye undertakes to show that the leaf-like structure first described by Spence Bate in the Challenger report on the Macrura as an appendage of the secondary sexual organ of *Penœus* is not formed on the animal that bears it, but in the dilated end of the ductus ejaculatorius as a secretion, and that probably it is carried over to the female during copulation. It has no cellular structure whatever, and is found in a rolled up condition in the ducts of the males.

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[1] The Zoological Magazine, Tokio, VIII, 59.

It was described by Spence in the Japanese variety of *P. canaliculatus*, and is to be found, though not so conspicuously, in *P. semisulcatus*, *P. curvirostris*, *P. monocerus?* and *P.* sp.—(The Japanese *mayebi*). Dr. Kishinouye's observations were made chiefly upon *P. canaliculatus* and *P. monoceros?*—F. C. K.

Nerve-endings in the rennet glands of the Vertebrate Stomach.[1]—The nerves spreading out over the serous membrane of the vertebrate stomach arise from the plexus of Meisner and form two other plexi—one under the rennet glands, the other below the ephithelium of the stomach. The simple nerve fibers form a plexus about the membrana propria of the glands and now and then pierce it, spreading their fine branches out around the cells. Each branch ends in a varicosity, but does not penetrate the cell as supposed by Nawalichin and some others. In this conclusion Dr. Kytmanow, the author of the paper cited, is in agreement with Erich Mueller, Smirnow, Arestein and others who have studied the peripheral or epithelial terminations of nerve fibers. His study upon the stomach of the cat was undertaken to determine surely what Erich Mueller had left as uncertain, namely, whether the fibers terminate inter- or intra-cellularly. For this he employed the Golgi, methylen blue and gold chloride methods. With the first he was unsuccessful, but with the other two, especially with the methylen blue, he arrived at the conclusion that has been given.—F. C. Kenyon.

The Breeding Haunts of Ross' Gull.—One of the valuable ornithological facts that the "Hero of the White North," Nansen, has to relate, is that he has discovered the breeding station of the circumpolar gull, *Rhodostethia rosea* Macy. The small group of islands which he calls the Hirtenland group, where he found the birds in large numbers and breeding, lie in 81° 38′ N. Lat. and 63° E. Long. They seem to occupy a position within an area laid down by Payer as Wilczek land.

Proper name for the Western Horned Owl of North America.—In the "*Auk*" for April, 1896, p. 153 I published a revision of North American Horned Owls in which I showed that the name *subarcticus* Hoy. was a synonym of *arcticus* Swains, and hence untenable for the light colored *Bubo* of the western states.

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[1] Intern. Monatsch. Anat. Phys., XIII, 402–5.

In the same paper I proposed to recognize the small Bubo of southern California as a distinct subspecies under the name *pacificus* Cassin.

For the old "*subarcticus*" I proposed the name *occidentalis* and selected for my type a specimen from Mitchell Co., Iowa (No. 26435, Coll. Acad. Nat. Sciences, Phila.) which showed the greatest contrast to the small Californian race.

This specimen, however, unfortunately proves to be intermediate between *B. virginianus* and *arcticus* and does not belong to the race which I had intended to rename; the latter not extending so far east (See Auk., Jan., 1897, p. 132.)

Such being, the case my name "*occidentalis*" must be relegated to synonymy and I would propose for the Horned Owl of the interior United States (the "*subarcticus*" of authors, nec. Hoy) the name *pallescens*, designating as the type, No. 152219, Coll. U. S. Nat. Mus. ♂ Watson Ranch, 18 mi. S. W. of San Antonio, Texas.

Bubo virginianus pallescens is smaller and paler than the true *virginianus* (the wing measuring 13.75 in.) with much less rufous admixture. The barring on the belly is much finer and the feet almost pure white.

While not differing so much in size from *B. v. pacificus* as indicated in my former paper (Auk., 1896, p, 156), its coloration is quite distinct. The latter race is darker than *pallescens* with more black admixture above, heavier bars on the belly and with the feet more mottled with rufous and brown.

In entering *Bubo virginianus pacificus* Cass. in the Supplement to their Check List the American Ornithologists' Union Committee have added to the confusion by giving it the same number as has already been given to *B. v. saturatus.*

The various races of our Horned Owls should now stand as follows in the A. O. U. List:

375. *Bubo virginianus* (Gmelin). Great Horned Owl.
375a. *Bubo virginianus pallescens* Stone. Western Horned Owl.
375b. *Bubo virginianns arcticus* (Swainson). Arctic Horned Owl.
375c. *Bubo virginianus saturatus* Ridgway. Dusky Horned Owl.
375d. *Bubo virginianus pacificus* Cassin. Pacific Horned Owl.

—WITMER STONE, *Acad. Nat. Sci., Phila.*

An Incomplete List of the Mammals of Bertie Co., N. C.—During the years 1891, 1892 and 1893 we received a number of small mammals in the meat and in alcohol, from Bertie Co., N. C. The specimens came from that part of the county which lies a few miles west of the shore of Albemarle Sound, and about midway between the Tar and Chowan Rivers. Nothing larger than a Flying Squirrel was sent, hence the list is by no means a complete one, though it contains several records of interest. The following were the species obtained:

1. *Microtus pinetorum.*—One specimen, Jan. 22, 1891, and three in July, 1891. (*Microtus pennsylvanicus,* one of our commonest mice at Raleigh, was not obtained at all.)

2. *Peromyscus leucopus.*—Twenty-one specimens were received of this species, showing it to be the predominant Deer Mouse of the locality as against the next.

3. *Peromyscus gossypinus.*—Four specimens of this species were secured, one being in the bluish pelage of the young.

4. *Peromyscus aureolus.*—Thirty-seven specimens. The larger number received of this arboreal species was due to the ease with which they can be caught in their nests, when one once knows just where to look for the said nests.

5. *Reithrodontomys lecontei.*—Ten specimens of the Harvest Mouse were received. Like *P. leucopus* and *P. gossypinus* they were mostly caught in traps.

6. *Sciuropterus volans.*—Four adults and three young of the Flying Squirrel were received.

7. *Putorius noveboracensis.*—Two young Weasels, a male 265 mm. in total length, and a female 234 mm., were the only carnivora contained in the collection. Date of capture, May 16, 1892.

8. *Scalops aquaticus.*—Four specimens of the Common Mole were taken July 9, 1891; March 24 and April 22, 1892, and March 18, 1893.

9. *Blarina parva.*—Twelve specimens were dug out of an old stump on Jan. 21, 1892, and four others were also secured.

10. *Sorex longirostris.*—One specimen, collected June 13, 1892.

11. *Atalapha borealis.*—Thirty-six specimens of the Red Bat were obtained. This and the next are evidently the common bats of the locality.

12. *A. cinerea.*—Three specimens of the Hoary Bat were collected, one each on Oct. 10 and Nov. 1, 1892, and April 8, 1893.

13. *Nycticejus humeralis.*—Sixty-one specimens. Of twenty-seven specimens caught roosting in an old house on June 18 and July 1, 1891, all were females.

14. *Vesperugo carolinensis.*—Of this bat, one of the commonest at Raleigh, only six specimens were received.

15. *Adelonycteris fusca.*—Three specimens of the Large Brown Bat were secured, taken on Aug. 17, 1891, and March 7 and Nov. 9, 1893.

16. *Lasionycteris noctivagans.*—Six specimens of the Silver Black Bat were taken, four on July 1, 1891, and two (caught in a hollow tree) Dec. 26, 1892.

17. *Vespertilio lucifugus.*—Three specimens of the Little Brown Bat were taken, one each on July 9, 1891, Aug. 3, 1892, and July 17, 1893.

18. *Plecotus macrotus.*—Big-eared Bat. One specimen was taken on Feb. 1, 1893, and two on Oct. 24, 1894. This bat and *Atalapha cinerea* have also been taken at Weaverville, in the western part of the State, but not as yet here at Raleigh. The specimens were furnished to us by Messrs. Thos. A. Smithwick, of Walke, and J. W. P. Smithwick, of Sans Souci.—C. S. BRIMLEY.

Preliminary Description of a New Race of the Eastern Vole from Nova Scotia.—There is in Nova Scotia a small, bright-colored vole with small hands and slender feet that seems subspecifically distinct from the large dark-colored southern *Microtus pennsylvanicus typicus.*

It lives in great numbers in the fields and fresh water marshes, but especially in the glade-like openings in the spruce forest, where little spring brooks run down through the beds of rushes (*Juncus* sp.) among which its runways can be seen in all directions.

The new form, based on a series of sixty-three specimens, may be characterized as follows:

MICROTUS PENNSYLVANICUS ACADICUS subsp. nov. *Type* from Digby, Nova Scotia, No. 2155 ♀ old adult, Coll. of E. A. and O. Bangs. Collected by O. Bangs, July 22, 1894. Total length 172, tail vertebræ 49, hind-foot 20.

General Characters.—Size smaller than *M. pennsylvanicus typicus*; hands very small; feet slender; colors bright; skull smaller than that of *M. pennsylvanicus typicus* and lighter throughout; incisor teeth much more slender.

Color in winter pelage, upper parts bistre-brown, somewhat shaded with russet, with very few black-tipped hairs intermixed; under parts dark gray, often washed with buffy.

In summer pelage, upper parts with russet the predominating color. (At this season *M. pennsylvanicus acadicus* is much paler and brighter colored than *M. pennsylvanicus typicus.*)

Cranial Characters.—Skull smaller than that of *M. pennsylvanicus typicus* and lighter throughout: pattern of enamel folding of molar teeth similar; incisor teeth much more slender.

Size of skull (average measurements of ten old adult topotypes).—Basilar length 23.9, Basilar length of Hensel, 22.8, zygomatic breadth 14.7, mastoid breadth 11.8, greatest length of single half of mandible 15.6.

Size.—Average measurements of fifteen old adult specimens, males and females, from Digby, Nova Scotia, total length 167, tail vertebræ 45, hind-foot 20.3.

Remarks.—Compared with *Microtus frontigenus*, *M. pennsylvanicus acadicus* is larger and much more brightly colored, and has smaller audital bullæ.—OUTRAM BANGS.

A New Race of Gibb's Mole.—In his recently published Revision of the American Moles,[2] Mr. F. W. True treats Gibb's Mole, *Neürotrichus gibbsi* (Baird), from the whole coastal strip from British Columbia to San Francisco Bay as one form, although he points out the fact that Southern examples are larger than Northern ones. I have long considered the species to be made up of two well-defined and easily recognized races, for the Southern one of which I now propose the name:

NEÜROTRICHUS GIBBSI HYACINTHINUS subsp. nov. *Type* from Nicasio, Marin Co., Cal., ♀ old adult, No. 1240, Coll. of E. A. and O. Bangs. Collected by C. A. Allen, March 10, 1894. Total length 127, tail vertebræ 41.4, hind-foot 17.5.

General Characters.—Size considerably larger than *N. gibbsi typicus;* color uniform black, instead of deep brownish-plumbeous as in *N. gibbsi typicus;* skull larger and relatively broader.

Color.—Black all over, with in places green and purple irridescence; under fur black.

Cranial Characters.—Skull larger and relatively broader than that of *N. gibbsi typicus.*

Size of the type skull, Basilar length (basion to front of premaxilla) 19.8, mastoid breadth 11.4. (One of the largest skulls of *N. gibbsi typicus*, from a series of eighteen from Sumas, B. C., No. 5513, Bangs Coll., measures: Basilar lengih 18.4, mastoid breadth 10.2.)

Size.—Average measurements of two adult specimens from the type locality: total length 123.8, tail vertebræ 39.7, hind-foot 17. (The average measurements of the ten largest adult specimens of *N. gibbsi typicus*, from a series of eighteen from Sumas, B. C., are: total length 116.4, tail vertebræ 38.4, hind-foot 17.4.)

Remarks.—I am unable to say just where the two races of Gibb's Mole meet; but the San Francisco Bay specimens are very different from the British Columbia ones, and well warrant dividing the species into a small plumbeous Northern and a large black Southern race.

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[2] Proceedings U. S. Nat. Mus., Vol. XIX, No. 1101.

In the summer of 1896, Mr. Allan C. Brooks took a series of *N. gibbsi typicus* on Mount Baker, at the very edge of the perennial snow. He says these specimens do not differ in any way from those taken in the lowlands about Sumas, B. C.—OUTRAM BANGS.

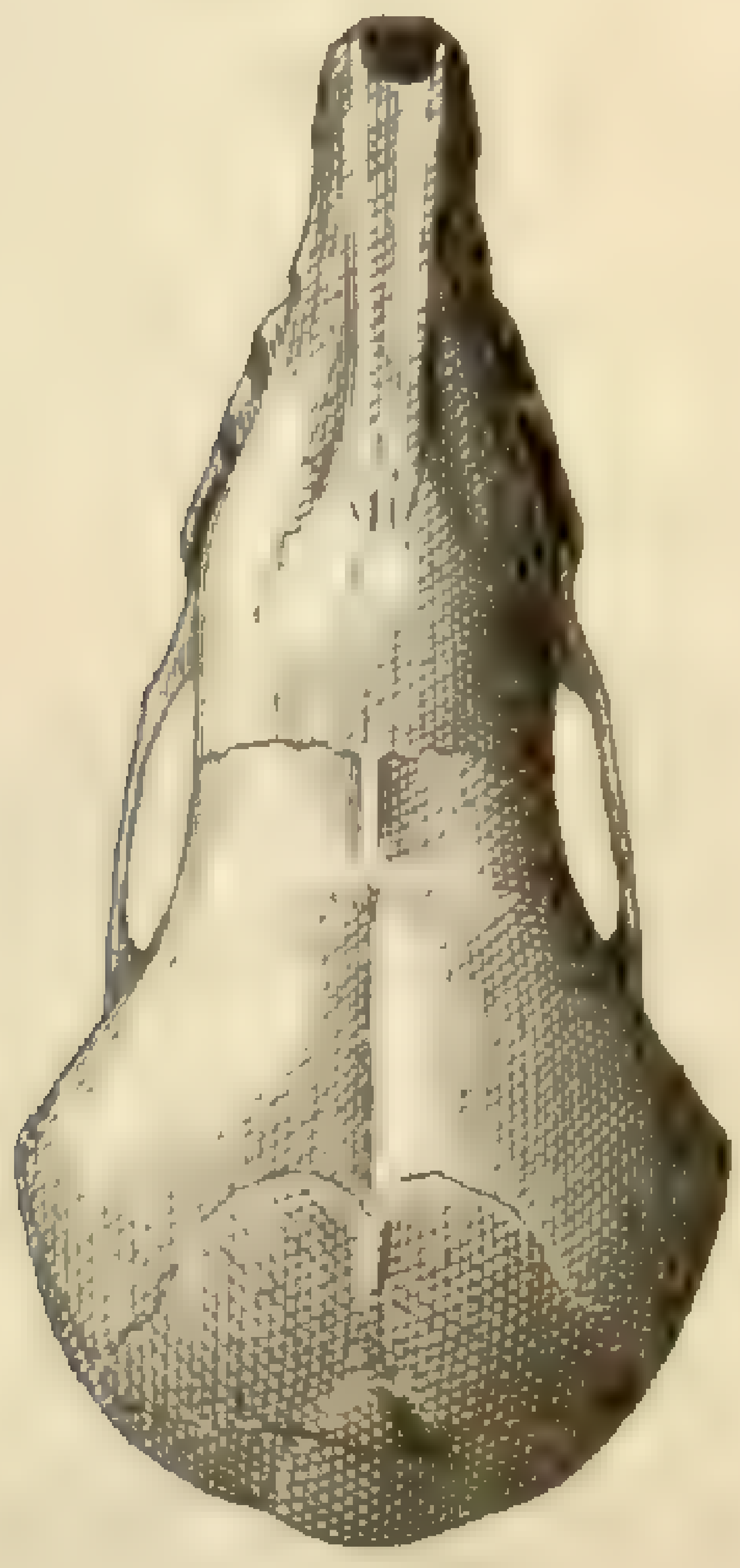

FIG. 1.

Fig. 1. *Neürotrichus gibbsi typicus* (No. 5513, Bangs Coll.) x $\frac{3}{2}$.

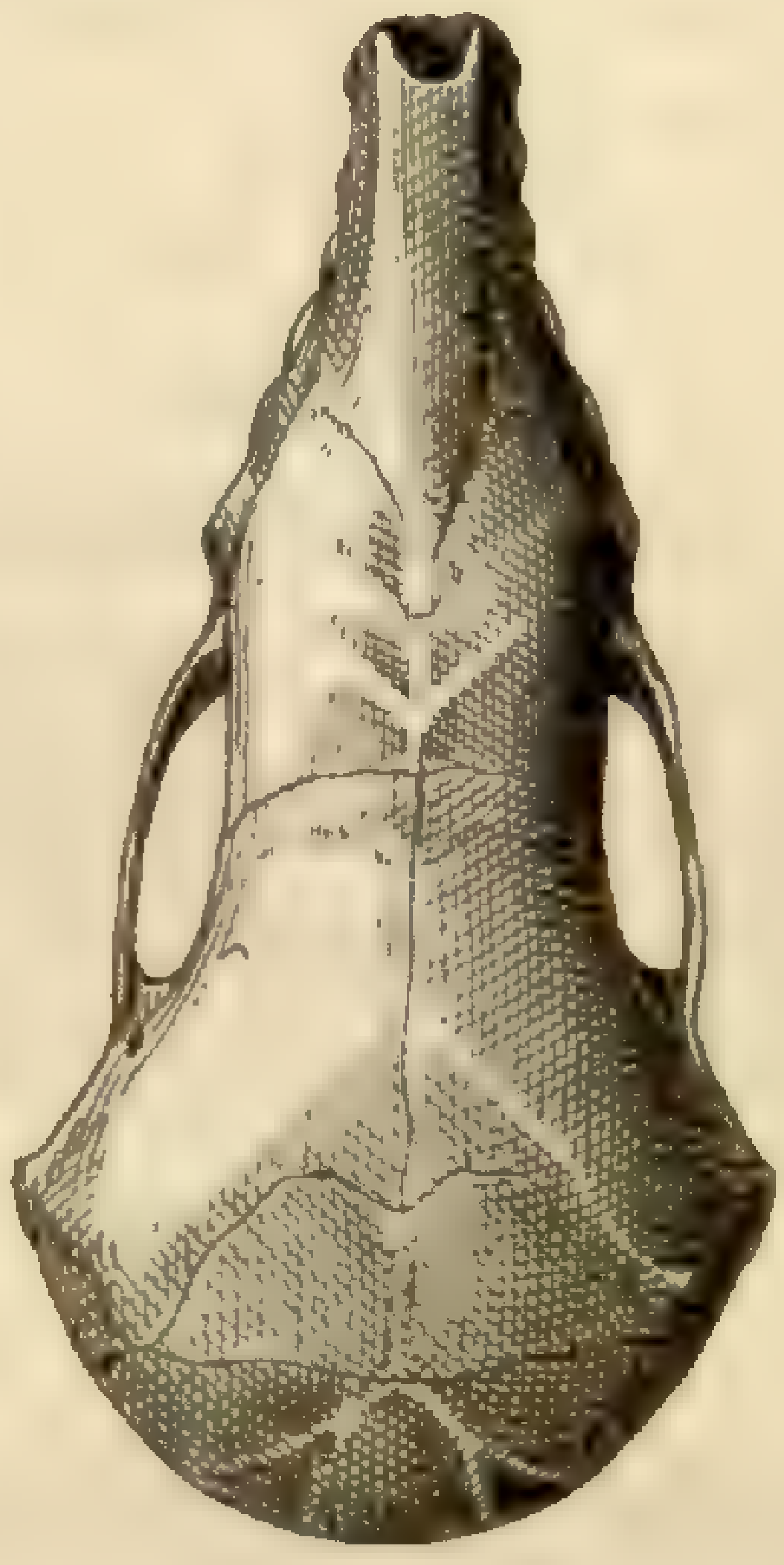

FIG. 2.

Fig. 2. *Neürotrichus gibbsi hyacinthinus* (Type) x $\frac{3}{2}$.

Zoological News. PROTOZOA.—Among the Protozoa described by Dr. C. A. Kofoid for the Traverse Bay region of Lake Michigan[3] there are 22 Rhizopoda, 5 Heliozoa, 20 Mastigophora, and 34 Infusoria. The close correspondence between the European and the American Protozoan fauna is shown in the fact that out of the 81 species that he lists 73 are also found in Europe. With two exceptions, *Podophrya cyclopum* and *Glenodinium cinctum*, every one of those that he records as limnetic species (i. e., those found in open water) are also found at Plön, as recorded by Zacharias.

TURBELLARIA.—Two new species of Turbellaria are described as *Phonaria simplex* and *Mesostomia wardii* respectively in Bulletin No. 6 of the Michigan Fish Commission.

ROTATORIA.—In the same Bulletin, H. S. Jennings describes a new rotifer, *Distyla signifera*.

MOLLUSCA.—In a list of the mollusks of Tennessee,[4] embracing 71 species of Pelecypoda, 41 being aquatic and 54 terrestrial Gasteropoda,

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[3] Bull. 6, Mich. Fish. Com.

[4] Contributions to the Zoology of Tennessee, No. 4, Mollusks. H. A. Pilsbry and S. N. Rhoads. Proc. Phil. Acad. Sci., 1896, p. 499.

I note the description of one new species, *Anculosa harpethensis* Pilsbry. It is distinguished from *A. subglobosa* Say. by its globular form and the angulation at the base of the columella; " face of columella concave, a projecting angle at union of columellar and basal lips."

MAMMALIA.—The mammals collected by Dr. A. Donaldson Smith during his expedition to Lake Rudolf, Africa, representing 50 genera and 77 species, 7 of which are new, have been described in the Proceedings of the Academy of Natural Science of Philadelphia (pp. 517–546) by Mr. S. N. Rhoads.

EMBRYOLOGY.[1]

Spinning Powers of Certain Eggs.—It is well known that the protoplasm of many one-celled animals may flow out as excessively delicate threads of living matter that exhibit remarkable currents and contractile phenomena. Something similar to these filose "pseudopodia" is met with in certain cells of many-celled animals, as in the pigment cells of the retina, etc. In a recent paper by Gwendolen Foulke Andrews[2] it is claimed that the eggs of star-fish and sea-urchins form very much the same sort of delicate pseudopodial filaments as are produced in those one-celled animals.

These thread-like processes are "spun" out from the protoplasm of the egg in such exceedingly delicate filaments that they have escaped notice and have now been revealed only with good lenses and exceptional optic resources.

From the elevation of the egg's surface that meets the sperm a "*tuft*" of fine threads is spun out; the whole surface of the eggs spins out fine threads to make the egg membrane; the egg spins during cleavage; it spins out the cilia that move the blastula; it spins filaments across the cleavage cavity and from one germ-layer to another in the gastrula; and the polar bodies spin like the rest of the egg.

These threads spun out are flowing material that branches, anastomoses, shows currents and other phenomena very much as do the pseudopodial filaments of such one-celled animals as Gromia.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Journal of Morphology. February, 1897, pps. 367–389.

The membrane that is formed after entrance of a sperm is made in the sea-urchin by the following spinning phenomena. In normal eggs of Echinus clear, homogeneous, straight, smooth filaments flow out from the egg, very close together, and all attain the same length about the same time. These filaments then seem to fuse at the tips to make a ceiling-like film that grows thicker. The space between the filaments is then filled in—in some undetermined way—and thus the membrane is completed.

In abnormal eggs the spinning is irregular and more in the form of tufts and brushes that are more readily observed.

In the star-fish after such a membrane is formed the egg sends out a tuft of threads from the place where the polar bodies were formed and then ceases to spin; soon the general surface spins again and continues to do so during cleavage. These filaments branch and anatomose; they may bend suddenly at the base and even bend over at right angles at some point in their course; they may start from the surface of the egg at various angles even tangentially; they may run out and attach themselves to the egg membrane.

When cleavage of the egg begins, the spinnings show peculiar activity near the plane where the cells will separate. As the cleavage furrow is formed threads spin from one side to the other so that the two cells are connected by cross filaments as fast as they are separated by the plane of cleavage. The liquid between the cells is crossed by many most delicate strands and skeins of filaments that connect the two cells.

When the two cells subsequently approach and flatten against oneanother the connecting strands shorten and thicken as if contracting to draw the cells together. When pressure is applied to such cells the connecting threads appear as if resisting separation of the cells and as if more active in drawing them together.

Later when more cells are formed the same phenomena are seen and when the cleavage cavity is present it is crossed by a network of interlaced filaments spun out from the inner ends of the cells. These filaments connect adjacent cells and also the most remote cells of the blastula.

When the blastula is ready to swim, the external spinnings cease for a while and then start again as numerous processes from the general pellicle all becoming very long and active as the well known "cilia" that propel the blastula through the water.

In the gastrula stage both entoderm cells and ectoderm cells spin filaments that cross the blastocœle and connect all the cells. When the mesenchyme cells are formed they too spin many filaments that connect with the other cells and with other filaments so that the blastocœle is traversed by a very complex network of anastomosing filaments arising from all the germ layers. These internal spinnings remain active up to the time of formation of the proctodæum, at least.

The polar bodies spin, from the first, very fine pseudopodial filaments that soon unite with the egg and with the egg membrane as well as with filaments from the egg so that the polar bodies are henceforth (up to the period of the late gastrula, at least) united to the egg, and to the resulting cells, by threads of living material.

The shape of the polar bodies may be changed as if distorted by contraction of these filaments; and change of place of the polar bodies seems also to be due, at times, to contraction of the filaments.

In the anastomosing network that connects the egg with the polar bodies material is carried hither and thither in the currents that flow along the threads.

Eventually the polar bodies may be taken in to the blastula, through the cleavage pore, and henceforth be connected with the network spun out from the inner ends of the blastula cells and, later, with the filaments from the entoderm cells of the gastrula also.

The natural criticism that these spinning phenomena are abnormal, pathological, and hence of less wide interest, is met by the author with the statement that every precaution was taken to maintain normal conditions and that the eggs described were from lots that formed normal larvæ, or even themselves grew into normal larvæ after the observations. Moreover it is granted that heat, polyspermy, immaturity of the egg and adverse states of the water resulted in very profuse spinning phenomena, but these truly pathological phenomena were very different in character and easily distinguished from the less obvious phenomena believed to be undoubtedly normal.

It is thus claimed that in these normal Echinoderm eggs the protoplasm can project delicate living filaments. That these are concerned in the formation of the egg membrane. That they connect the cells during cleavage and gastrulation so that *the protoplasm is continuous throughout the larva and not separated by the cell walls.*

As appearances indicate that these connecting filaments are contractile and that they aid in drawing the cells together, they may thus prove to be the basis of the so-called "cyto-tropic" movements exhibited by the blastomeres of various eggs.

Moreover as these filaments are living bands and as material passes along them from one cell to another, the author thinks they may prove to be the means of that coordinating communication in the cell-aggregate postulated by certain workers in the field of experimental embryology.

The polar bodies are said to spin like the cells of the egg for a long time after their formation and to remain so long in protoplasmic continuity with the other cells that there is a possibility they may not be entirely without a place in the developmental changes.

The peculiar activities of the protoplasm of these eggs together with many general questions connected with such phenomena will be considered in a second paper, now in press.

Though these remarkable phenomena are new to our knowledge of eggs the reviewer would suggest that what is here seen as living filaments may have appeared to other observers as a protoplasmic envelope on the outside of the egg. Thus it may be that the very thick covering "*Protoplasma mantel*" figured and described by Selenka[3] in the Ophuirid *Ophioglypha lacertosa* and the much thinner "*Protoplasma schicht*" in the Echinid *Strongylocentrotus lividus*, which also enters the cleavage cavity, are really a collection of spinnings, possibly somewhat pathological. In the last named case this outer envelope of the egg has recently been emphasized by Hammar[4] as a connection between the cells.

PHYSIOLOGY.

The action of the venom of the Australian Black Snake.—From numerous experiments detailed in a lengthy paper in the Journal and Proceedings of the Royal Society of New South Wales[1] C. J. Martin concludes briefly that the venom of the Australian black snake (*Pseudechis porphyriacus*) is comprehensive in its action, but affects principally the three most vulnerable points of the higher organism, namely, the blood, heart, and the respiratory center in the medulla. Its method of destroying life depends essentially upon the concentration with which the venom reaches the circulation. When the concentration reaches a certain limit, death may be almost instantaneous from a coagulation of the blood, thus ending circulation. If the concentration falls short of this the venom has the opposite effect of destroying the capacity of the blood to clot when shed. When this is the case any

[3] Studien über Ent. Hft. 2. Wiesbaden, 1883.

[4] Archiv. f. Mik. Anat. March, 1896.

[1] XXIX (1896), pp. 146–278.

further injection of the venom fails to cause clotting within the vessels (thrombosis.)

The action of the poison upon the heart and respiratory center is usually simultaneous. With the higher concentration it is the heart that fails first, with the lower concentration, it is respiration. Hence according to the concentration of the dose death may occur in from one to three days from clotting of the blood within the vessels, from cardiac failure, or from respiratory paralysis.

If the animal succeeds in passing these three possibilities it may yet succumb from secondary pathological changes in the lungs and kidneys. This last is not, however, a large risk, except in dogs, and if the animal survives the nervous and circulatory depression it usually recovers with wonderful rapidity.

The animals experimented upon were frogs, turtles, pigeons, rabbits, cats, dogs, and for man, upon his own blood. From the details that he records it is interesting to note that the venom destroys the red blood corpuscles, causing the hæmoglobin to dissolve out into the serum and escape through the kidneys in a crystalline form. In blood observed beneath the microscope the red corpuscles swell up to spherical masses, become transparent and finally disappear. All amæboid action in the white corpuscles is stopped. They finally become very granular, the nucleus appears distinctly as when the corpuscles are treated with acetic acid. Finally they are destroyed.

One very noticeable feature is that in common with other venom that of *Pseudechis* at first causes a scarcity of the white corpuscles; then this condition is followed by one in which they are more than normally present.

The action of the venom upon the dog is about ten times greater weight for weight, than upon any other animal. He says that the lowest limit of concentration necessary to produce the destruction of the blood corpuscles either within the body or *in vitro* is for dogs .00001 grammes of the venom to 100 c. c. of blood. The corpuscles of rabbits, guinea-pigs, cats, and white rats are much less easily destroyed. A concentration of .005 per cent. produced no destruction of the corpuscles of his own blood.

The blood plasmas that have lost all spontaneous coagulability may be coagulated by, (1) the addition of a saturated $NaCl$ solution up to an equal volume, (2) the addition of an equal volume of a saturated solution of $MgSO_4$, (3) the addition of acetic acid until there is a slight evidence of acidity of the plasma, and (4) by the similar addition of sulphuric, hydrochloric, or phosphoric acid (Oxalic acid is ineffectual).

Very much larger amounts of the venom may be injected subcutaneously without producing the effects that follow intravenous injections. In this case the author thinks that the blood acquires an immunity to further doses. How long this immunity may last, however, he is not able to say.

The blood pressure (arterial) in the case of intravenous injections gradually falls until death. In the case of subcutaneous injections it falls for a while, then rises to near the normal and again falls until the death of the animal.

With this change in the blood pressure there is a corresponding change in the volume of the spleen and kidneys, both increasing in volume with the fall of blood pressure and decreasing with its rise.

The venom lessens the power of the blood to carry CO_2 and decreases the toxic powers of the serum over micro-organisms.

Heating to 85°C. lessens the power of the venom to destroy blood corpuscles and also its toxic qualities generally. This may be explained by the heat converting some of the proteids of the venom into an inert precipitate and secondly by its causing some change in their toxic power without, however, impairing their solubility or changing them in any may recognizable by chemical means.

Upon the nervous system the venom does not, as has been recorded for that of other snakes, have a curare-like action, but like them it causes a general paralysis, beginning with the lower and passing successively to the higher centers. Dogs poisoned with *Pseudechis* venom loose first the use of their hinder limbs.

There is no increase of respiration followed by a decrease as has been noted in other experiments, but instead a gradual decrease in both the amplitude and the number of respirations coinciding with the fall of blood pressure, except where the venom reaches the blood indirectly as in subcutaneous injections or through serous surfaces. In such cases there is a tendency to return to the normal.

The effect upon body temperature is such as to cause a rise or a fall in temperature according to the manner in which the venom reaches the blood, if this be slowly, it may cause a rise, if rapidily, a fall. As in the case of *Crotalus* venom as found by Sewall in animals more or less immunized by repeated small injections, a lethal dose may be followed by a rise in temperature.

Among the other pathological effects may be noted that it causes hæmorrhages in all of the organs of the body and from the mucous surfaces. Hæmorrhages are especially to be noted in the lungs. The urine of animals poisoned by *Pseudechis* always contains albumen, sometimes hæmoglobin, and frequently blood.

An idea of the toxic value of the venom may be obtained by comparing it with other poisons, basing the comparison upon the number of grammes of an animal, viz., a rabbit, killed by one gramme of the venom injected subcutaneously.

Cobra	4,000,000.
Hoplocephalus curtus	4,000,000.
Pseudechis	2,000,000.
Diptheria toxine	4,000,000 (about.)
Anthrax albuminoses	80.
Toxo-peptone	3,000.

—F. C. Kenyon.

PSYCHOLOGY.[1]

The Year 1896 in Scientific Psychology.—While the past year has shown no startling developments in psychology, it has been marked by steady progress and an unusual amount of activity. The experimental laboratories everywhere have been busy, and a large number of Laboratory Studies have been published.

In this country the activity has been especially marked; the *Psychological Review* and the *American Journal of Psychology* have devoted more than usual of their space to experimental work. The psychological department of Cornell University has moved into larger quarters in Morrill Hall, where it is reported to have nine rooms and 4,000 square feet of space. The laboratory at the University of Nebraska has moved into the new library building, and occupies a series of five rooms and 3,000 square feet of space. A laboratory of experimental psychology has been fitted up during the year at the University of Kansas, under the charge of Prof. Olin Templin. The University of Chicago and Columbia University are preparing to establish their laboratories in ampler quarters, when the new buildings are completed.

In Russia it is reported that the Universities of St. Petersburg, Moscow and Kieff have taken steps, in connection with the Minister of Education, looking to the establishment of psychological laboratories. The University of Kieff has petitioned for an appropriation of about

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[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.

$3,000 to equip such a laboratory, and a yearly sum of $300 to maintain it. In addition to the older magazine, *Voprosi Philosophi i Psichologi*, which has always published a large number of psychological articles, a new Russian magazine has been started by Prof. A. A. Tokarsky, entitled *Zapiski Psichologetscheskoi Laboratori;* it is to be published quarterly as organ of the Psychiatrical Clinic at Moscow. Dr. W. von Bechterew has also established a new Review of Psychiatry, Neurology and Experimental Psychology, to be published monthly at St. Petersburg.

In Germany a new psychological "Archiv" has been started by Prof. Götz Martius, under the title of *Beiträge zur Psychologie und Philosophie*, as organ of the laboratory at the University of Bonn. Like the *Psychologische Arbeiten*, established a year ago by Prof. Kraepelin at Heidelberg, it is to be devoted chiefly to laboratory studies, and will appear at irregular intervals. We note also the unusual activity of the *Zeitschrift für Psychologie,* which during the past year issued three complete volumes and over, without any apparent falling off in the standard of its contents.

In France, the *Année psychologique* has been very much enlarged, and includes a number of original articles—partly from the Paris Laboratory—as well as summaries of all important books and articles in all languages that appeared during the preceding year.

The increase of general interest in psychology has shown itself in the unusual number of articles on the subject that have appeared in the popular magazines and those devoted to various departments of science. The number of books, pamphlets and articles of more especial interest to the psychological "Fachmann" has also been remarkably large, as appears from the increased number of titles in the forth-coming *Psychological Index.* The bibliography of the *Anné psychologique* has joined forces with the latter annual, which is now issued in both English and French. The bibliography of the *Zeitschrift für Psychologie* covers the ground for German readers.

Among the books that have appeared during the year we may mention Wundt's "Grundriss der Psychologie," a compendium of his lectures on general psychology ; this has already been translated into English by Dr. Judd of Wesleyan University. Prof. Jodl's "Lehrbuch der Psychologie," a book of some 760 pages, is the most notable German work on general psychology of the year. In England there have appeared a large two-volume work on "Analytic Psychology" by Mr. G. F. Stout, the Editor of *Mind*, and the "Elements of Psychology" by the late G. Croom Robertson, edited from his lecture notes by Mr. Rhys

Davids. In this country Prof. Titchener's "Outline of Psychology" is the leading contribution to empirical psychology. Among the more specialized works published during the year may be noted "Habit and Instinct" by Lloyd Morgan; "Studies of Childhood" by James Sully; and "La psychologie des sentiments" by Th. Ribot.

The important event of the year in psychological circles was the Third International Congress of Psychology, which met at Munich, August 4th to 7th, whose proceedings have already been reported in this journal. The meeting of the American Psychological Association in Boston, December 29th and 30th, has also been noticed here. In April, 1896, the New York Academy of Sciences formed a section devoted to psychology, anthropology and philology, whose meetings were to be held monthly. American psychologists have been invited to attend the meeting of the British Association at Toronto, next summer, in connection with the physiological section of that body. There is a movement on foot to secure a more adequate representation of psychology in the American Association for the Advancement of Science, under the section of anthropology. The International Bibliographical Conference, which met in London, voted to include psychology among the 15 leading sciences to be catalogued.

A prize of £50, to be called the Welby Prize, has been offered for the best treatise upon the following subject: *The causes of the present obscurity in psychological and philosophical terminology, and the directions in which we may hope for efficient practical remedy.* The committee in charge consists of Prof. James Sully, London; Mr. G. F. Stout, Aberdeen; Prof. E. B. Titchener, Cornell (Ithaca); Prof. Oswald Külpe, Würzburg; and Prof. Emile Boirac, Paris. The papers may be written in English, French or German, and are to be handed in before January 1, 1898.

The Macmillan Co. announce a "Dictionary of Philosophy and Psychology," which is now being prepared under the editorial supervision of Prof. Baldwin, of Princeton University. The topics in normal psychology are in charge of Prof. Cattell of Columbia University, G. F. Stout, W. E. Johnson of Cambridge University, Prof. Titchener of Cornell University, and the Editor; the department of mental pathology and anthropology is assumed by Prof. Jastrow of Wisconsin University, and that of biology by Prof. Lloyd Morgan of University College, Bristol. The work is expected to be ready during the present year.

Necrology.—Prof. J. Delbœuf, of the University of Liège, died at Bonn on August 14, 1896, at the age of 65 years. In addition to his works on hypnotism, which have given him an international reputation, he wrote on fatigue, sleep, the psycho-physical law and other experimental topics.

Prof. R. Avenarius, of the University of Zurich, editor of the *Vierteljahrschrift für wissenschaftliche Philosophie*, died on August 18, 1896.

Prof. M. W. Drobisch, of the University of Leipzig, died on September 30th, at the age of 94 years.

The following changes in the *personel* of various universities have occurred during the year:

Mr. G. F. Stout, fellow of St. John's College, Cambridge, and editor of *Mind*, has been appointed to the Anderson lectureship on comparative psychology, recently founded at Aberdeen.

Prof. E. B. Delabarre, of Brown University, has been appointed director of the psychological laboratory of Harvard University for the year 1896–7, during the absence of Prof. Münsterberg. In the same university J. E. Lough has been appointed instructor in experimental psychology, and C. M. Bakewell instructor in psychology.

Dr. C. A. Strong, associate professor of psychology in the University of Chicago, has been elected lecturer on psychology in Columbia University; Dr. Franz Boas has been appointed lecturer in physical anthropology, and S. I. Franz and L. B. McWhood have been appointed fellows in psychology, in the same institution.

H. C. Warren has been appointed assistant professor of experimental psychology in Princeton University; J. F. Crawford has been appointed demonstrator in experimental psychology.

At Bryn Mawr College, Prof. Lightner Witmer, of the University of Pennsylvania, has been appointed to give a course in experimental psychology, and Dr. H. T. Lukens, of Clark University, has been appointed professor of education.

Dr. Mark Wenley, late examiner in philosophy in the University of Glasgow, and lecturer at the Queen Margaret College, has been appointed professor of philosophy in the University of Michigan; Dr. Edgar Pierce has been appointed instructor in psychology.

Dr. Herbert Nichols, formerly instructor in psychology at Harvard University, has been appointed lecturer in psychology at Johns Hopkins University.

Dr. Guy Tawney, demonstrator in psychology in Princeton University has been appointed to the chair of philosophy in Beloit College, Wisconsin, made vacant by the death of Prof. Blaisdell.

Dr. C. H. Judd has been appointed instructor in psychology at Wesleyan University.

Dr. Arthur Allin, honorary fellow in psychology at Clark University, has been appointed professor of psychology and pedagogy in the Ohio University at Athens.

Dr. C. A. Scott has been appointed to the chair of experimental psychology and child-study at the Chicago Normal School.

Dr. E. L. Hinman, of Cornell, has been appointed instructor in philosophy and psychology in the University of Nebraska.

Dr. Alice J. Hamlin, of Cornell, has been selected to teach psychology in Mount Holyoke Seminary.—H. C. WARREN.

Studies in the Telegraphic Language.—In the *Psychological Review* for January, Mr. Harter, of Indiana University, reports an elaborate study of the telegraphic language. The whole study occupied about three years, and consisted of three parts; a cross-examination of many operators, novices as well as experts; an experimental study of individual differences, by the use of the Marey drum; and a study of the curve of improvement in sending and receiving. The following are some of the most interesting results.

I. *The character of telegraphy as a language.*—Telegraphy is a true language, in which operators are able to think. At a rapid rate of receiving, separate words cannot be distinguished, but words and groups of words are distinguished as wholes. Just as in reading, a grammatical error in a message is at once detected by the receiver, even when he gives no attention to the sense. An expert operator is able to follow his own machine with its individual differences even in the midst of louder machines, and when transferred to a new machine or to new surroundings may be unable to receive. Operators are keenly alive to the presence of those with whom they communicate; so much so that novices are often paralyzed by stage fright. External disturbances confuse novices, but have no effect on experts. Subjective disturbances, while they confuse or paralyze novices, render experts more fluent. Experts, too, are able to express their emotions over the wire. Thus there is an *anger-flutter*, during which the sender exhibits every physical sign of passion. During the laughter signal, (an oft-repeated "ha,") on the contrary, the sender exhibits no sign of humor, though his subjective risibilities may be considerably excited.

II. *Individual differences in sending.*—Sixteen subjects were tested on eight repetitions of the sentence: "Ship 364 wagons via Erie quick." The study of the records on the Marey drum involved about twenty thousand measurements. From these were ascertained the relative length for each person, first, of all the telegraphic elements; second, of the elements in the word "via"; and third, of the elements in the letter *v*, for six subjects. It was found that the individual variations in each of these results had an identifying value for each individual, and that these differences persisted through different rates of speed. These variations are due to two factors, one accidental, standing in inverse ratio to skill; the other intentional, corresponding to inflection in speech. The latter factor is what gives operators so complete an ability to recognize other operators across the wire.

III. *The curve of improvement in learning.*—The sending curve rises more rapidly and more uniformly than does the receiving curve from the beginning of practice to the learner's maximum ability. In the receiving curve there are two "plateaus," one just preceding the ordinary telegraphic rate, and another, if the learner continues to practice increasingly difficult work, just above it. It then rises again till it *crosses* the sending curve. Experts can invariably receive more rapidly than send. The slower rate of improvement in receiving is due partly to an unavoidable lack of practice, together with greater pleasure in sending. But the plateaus have a special significance; for while they exhibit no measureable improvement, they are indispensable conditions of a more rapid improvement after they are passed.

Only intense effort educates in receiving. Even years of practice do not assure improvement unless there is a constant increase in the difficulties of the task. Every new step in advance seems to cost more than the former.

This detailed and careful study of telegraphy proves with scientific rigor that it is a true language, which becomes so thoroughly assimilated that thinking apparently resolves itself into the telegraphic shorthand, and which admits of delicate individual inflection and emotional expression. The principles, too, which underlie the process of acquiring it may have important pedagogical applications.—J. FORSYTH CRAWFORD.

Mrs. Helen Gardener on the Inheritence of Subserviency.—Mrs. Helen Gardener is a frequent contributor to that highly speculative and rarely scientific Journal the Arena. At the Congress of Mothers recently held in Washington she read a remarkable paper on heredity. As reported in the daily press it calls for some remarks, especially as it is stated that she says that her opinions "deal with demonstrable facts," and that her "theme is scientific." Her thesis is that "self-abnegation, subserviency to man, whether he be father, lover, or husband, is the most dangerous theory that can be taught to or forced upon a woman. She has no right to transmit a nature and a character that is subservient, inefficient, undeveloped", etc. This opinion is in large part based on the supposition that the mother's physical influence in heredity is greater than the father's and that the mother's mental condition is more certainly transmitted to the child than is that of the fathers. Now there is not the slightest scientific ground for such an opinion. It is a common opinion among the breeders of domesticated animals that the father transmits the mental, and the mother the physical qualities. Whether this be generally so or not, it is well known that in mankind the father's mental characters are at least as often transmitted as are those of the mother.

But one of the results of recent investigation into heredity is the establishment of the general principle that characteristics which are of a temporary or one-sexed character are not as easily transmitted as was formerly supposed. The germ-cells are so protected that long periods of time and long-continued influences are required to produce appreciable changes of character in a family or a race. This truth may spare mothers a good deal of anxiety as to the effects of their conduct during gestation, though of course unhygienic habits will produce diseased conditions in children. This, however, is disease and not character.

But the development of adaptability of character is absolutely essential to the existence of the family and of society. Nature has placed in the hands of the man the strength of body and mind to combat and use her forces to a degree far exceeding that with which she has endowed woman. It has, therefore, come about that woman has found her most congenial as well as useful field in the family. Moreover the perfect development of mankind requires that the altruistic traits shall be fostered as well as the egoistic. The natural functions of woman develop the former, while those of the man develop the latter. Fortunately it has results that both qualities have been inherited by each sex, but with the predominance in each of that which is most necessary in their respective fields. The course of human evolution has not tended to unify the sexes, but to diversify them. This is a well-known result of scientific research.

The paper of Mrs. Gardener has a distinct tendency to discourage the beneficent and altruistic role which woman fills in civilized society, and to strike at the root of that admirable adaptiveness of many women, which is a guarantee of domestic harmony. And this is of more importance to human civilization and development than any theory as to woman's so-called individual independence. Like all other theories of individualism and anarchism it tends of the destruction of coöperative life, which is in the family the basis of civilization.

This well understood position does not mean the neglect by woman of her intellectual life. In this she should be, as in her moral nature, as much a guardian of human progress as the man. But in the moral nature she should guard the altruistic, as man is forced to develop the egoistic; otherwise man is likely to develop egoism in excess, and degenerate rather than advance in the scale of spiritual being.

E. D. COPE.

ANTHROPOLOGY.[1]

Mr. Wilson's investigation of the Swastika Cross.—Two lines intersecting at right angles, to form a cross, make a *Swastika* (as the Buddists called it in Sanscrit) if you bend the ends of the four arms in the same direction. Drawn, painted, cut, woven, scratched or otherwise designed upon utensils, or objects of every day life, the interesting figure appeared first, it seems, in the bronze (possibly polished stone age) of Europe and though not found in the earlier chipped stone (Neolithic) period, was discovered later among the Etruskans, Greeks, and Troyans (at Hissarlik or Troy). It seems to have been unknown in Assyria, Babylonia, Phoenicia and Egypt, but was used in India before the Christian Era, and persists not only in the Orient but also among the Finns and Lapps, and in remote corners of Europe, while generally disused for the last thousand years in Christendom.

To establish its existence in the new world Mr. Wilson, in a handsomely illustrated volume (The Swastika by Thomas Wilson, Curator Department of Prehistoric Anthropology, United States National Museum, Washington Government printing office 1896) presents valuable evidence. His numerous illustrations show the figure carved on shells from the Fains Island and Toes mounds, Tennessee, silhouetted on the copper plates from the Hopewell tumuli in Ohio, doubtfully painted on a water jug from Poinsett County, Arkansas, and carved on a stone metate from Nicaragua and a slab of lime stone from Yucatan. The Kansas Indians drew it on their song charts as shown, we see it woven in the bead-necklaces of the Sacs, painted on a gourd rattle of the Pueblos and figured in the dry sand paintings of the Navajoes. So the lucky sign we are told ornaments the bead work of the Kickapoos

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[1] This department is edited by H. C. Mercer, University of Pennsylvania.

Pottawotamies and Iowas, and we are shown it decorating the bull hide war-shields of the Pimas of Arizona and painted on the triangular female waist covers " (fig leaves) " of the Caneotires river Indians of Brazil.

The book enumerates the theories of those investigators who would derive the Swastika from the sun, from the earth, from fertility, from the meander design, from the cross, from the fire drill, from the four quarters of the world, and of those who deny the possibility of accounting for it at all. But the interesting question raised by Mr. Wilson is how did it get to America? In answer to which certain American students would probably contend that it grew here, that the outline is too simple to have required suggestion from abroad, that pre-Columbian Americans might have taken to drawing, painting scratching or stamping it on any object at any time, thus only showingthat the human an mind under given environments acts similarly.

As opposed to this conservatism Mr. Wilson declines to class the Swastika among the simple things such as the drawing of circles crescent moons or animal tracks, the wearing of beads, or, I may add, the habits of whistling, beckoning or nodding assent,[2] etc., etc.—the easy and inevitable things that all men think of spontaneously and without suggestion from abroad. He will let the cross fall into this category but not the Swastika. To twist the cross arms into a Swastika is, he holds, an inconsequent after thought, and the figure is held to be peculiar, difficult and suggestive. Always associated with luck among modern North American Indians, marked on the triangular waist cover of the Brazilian Indian woman as upon the waist of the Goddess Artemis excavated at Hissarlik, why, he asks, did it not migrate from Asia before Columbus, as had migrated the winged globe to Mesopotamia (from Phoenicia and Egypt) the Greek fret to modern Europe (through Egypt from Greece) the Northumberland rampant lion (through Flanders from Albania) or the Austrian double headed eagle to Europe (through the Emperor Frederic II from the Turcomans and Hittites.)

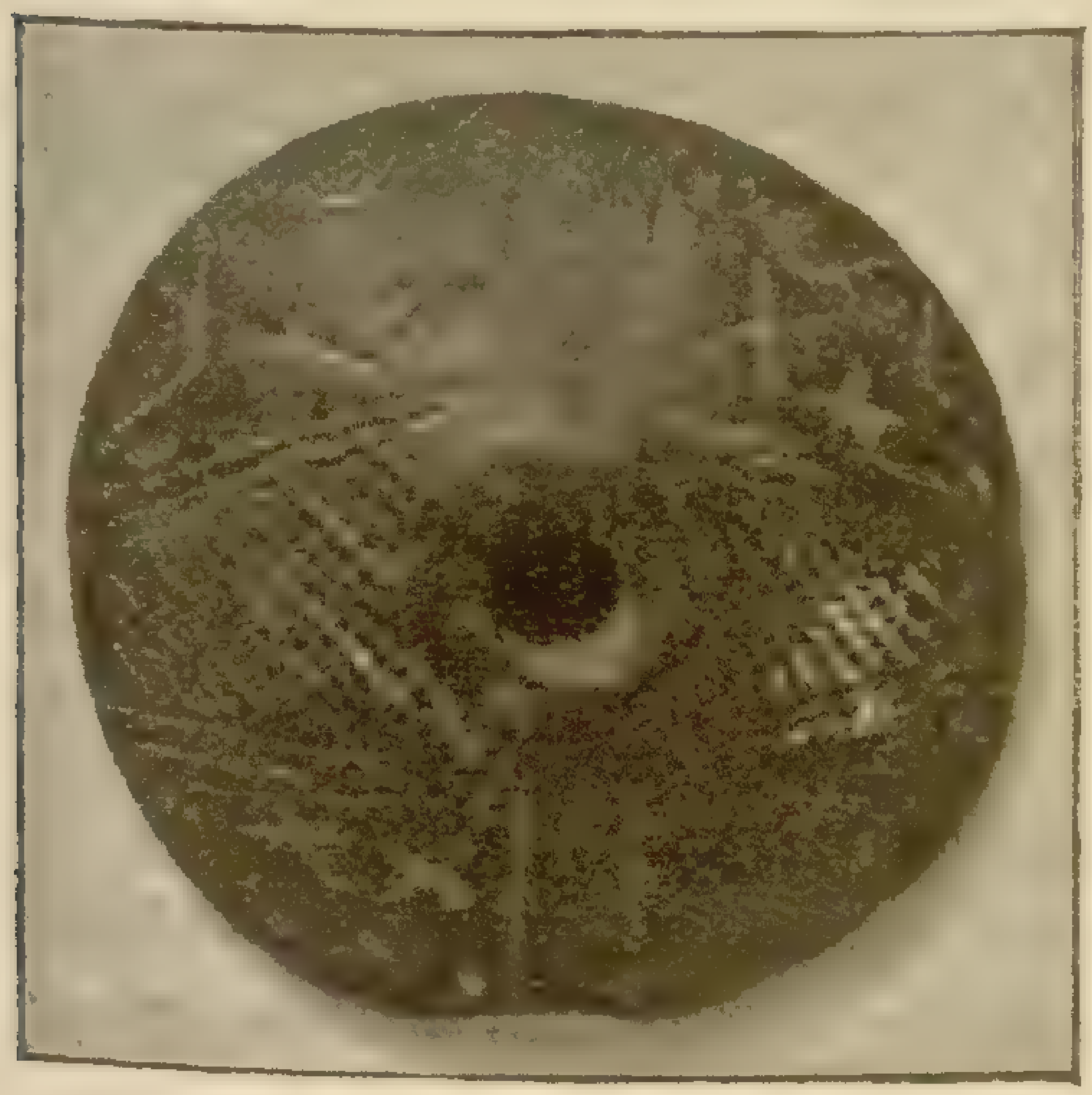
If it is as old as the European bronze age it is older than and might have migrated before Buddhism (6th century B. C.). So that it would not signify, as Mr. Wilson urges that no sure memento of Buddha worship has been found with it in the United States.

[2] I do not know whether the fact that the modern Egyptians who are inveterate singers, do not whistle has been noticed, but I heard no Arab or Fellah whistle a tune or whistle as Christians do to dogs or animals, etc., during a Nile journey and a two months visit to Cairo in 1881. In 1886 I was confused by the fact that the Jews and Turks in Salonica *shook* the head horizontally (our dissent) instead of nodding it to signify assent, and to beckon a person towards them, turned the right palm downward and motioned *outward* with the fingers.

Mr. Wilson does not claim to have presented more than a probability. But as science asks for demonstration we must wait for assurance of the trans Pacific origin of the American Swastika, well pleased with the author's interesting collection of evidence bearing upon the problem of the origin of American peoples.

The curious fact of the similarity in primitive weaving apparatus common to the Old and New Worlds is brought out. Small perforated discs, generally of earthenware, found in ancient Europe, the western United States, Mexico and South America, have been identified as whorls or weights for giving momentum to the spindle stick thrust through them, when twirled by the spinner over the knee and let go, just as women in remote parts of Germany and France have continued to whirl the spindle in recent years.

Of several thousands of these whorls unearthed by Schliemann in the city layers at Troy (Hissarlik), many were marked with the Swastika and some with the cross, while, strange to say, as Mr. Wilson shows, certain whorls from Mexico and South America exhibit likewise the cross (not Swastika) design. As yet more clearly testifying to the use of the cross as a symbol in ancient America upon spindle whorls, I take pleasure in illustrating here a whorl found by me while the present paper was in preparation, among the specimens entrusted me for classification by the Historical Society of Bucks County, Pennsylvania. It was recently obtained by Mr. J. W. Detweiler, of Bethlehem, from one of the ancient graves (probably pre-Columbian), regarded as of great antiquity by the modern natives, on the Rio Cauca Valley in the Republic of Columbia. It might be held that many of the American crosses shown by Mr. Wilson are, (like the cross stamp on an iron gas-plate, S. W. corner 7th and Arch streets, Philadelphia, that happened to catch my eye as I stepped on it yesterday), decorative intersections of lines or patterns, rather than symbols. In this specimen the



Perforated disc of earthenware, probably a spindle whorl marked like similar whorls found at prehistoric and protohistoric sites in Europe with the cross symbol. Eight small crosses are seen between the arms of the central larger cross. From the Museum of the Historical Society of Bucks County at Doylestown, Pennsylvania. Obtained by Mr. J. W. Detweiler, from an ancient Indian grave on the Rio Cauca Valley, Republic of Columbia. Museum No. 112. Actual size.

symbolic intent of eight small crosses between the arms of the larger central cross seems clear. No reasonable skeptic could deny the emblem. Its presence testifying to pre-Christian cross symbolism from the Levant to the Andes, stamping it upon one of the remarkable coincidences in craft apparatus, common to the Old and New Hemispheres, adds keenly to the interest of the object.

Mr. Wilson has tightened the lines about a theory, (that of parallel development) which may go too far in admitting original migration from Asia, but denying tokens of it. And the book adds weight to our persuasion of the existence of many objects of ethnological import discovered and undiscovered, which mean migration and race-contact after all, and can no more be explained by the theory of human minds working alike, than scarabs in Etruria—HENRY C. MERCER.

Exploration of Captain Theobert Maler in Yucatan.—Archæologists look with keen interest upon all researches made among that remnant of the Maya Indians of Yucatan who have taken refuge in the great forest. No less important the investigation which might devote itself to other tribes still inhabiting the fastnesses of Chiapas or Tabasco since it cannot be doubted that Archæological information of value has been preserved by these descendants of the most highly developed of aboriginal American peoples. Captain Theobert Maler is at this moment on the point of setting out on an expedition to that part of Tabasco inhabited by the *Lacandones* indians among whom he will inquire particularly for the existence of glyptical signs and any remembered trace of the art of hieroglyphic writing once characteristic of their ancestors. He informs me that certain interesting ancient industries are well preserved among them as for instance the making of incense burners (of clay?) adorned with human faces and painted with vivid colors, while the art of chipping arrow-heads and blades of flint still flourishes. With great interest we would follow the details of his search for a key that might open for us the long hidden meaning of the Maya literature, though he fears that the knowlege of the ancient symbols among the *Lacandones*, is entirely lost.—H. C. MERCER.

Cave hunting in Syria.—At the entrance of several rock shelters near Liban, Syria the Abbé Charles Moulier has recently found (see La. Nature, 25th, July, 1896) a series of chipped flint blades "well representing the types regarded as Mousterian, or of Reindeer age" in France. These objects which are never associated with specimens of polished stone, are discovered bedded in a reddish hard breccia mixed with the bones of animals. But strange to say, though the blades judged by their shape, are presumed by the finder to be (like their French duplicates) of Quarternary age, the bones represent animals still living in the country.

At two other surface sites El-Ouasahai and Santon, he finds a remarkable mixture of stone implements some chipped and others polished, together with innumerable potsherds, bits of marble, glass and mosaic and flint blades of various sizes and shapes, where from an archæological point of view it would appear that he had dug into several culture periods at once, though judged by the stratification it has as yet seemed impossible to make any distinction between epochs. A final detailed report of the work will be awaited with interest.—H. C. MERCER.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—February 3, 1897.—The following paper was read: Mr. William C. Bates, "Venezuela and Guiana, their Natural History, Scenery and People."—SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences, Biological Section.—January 11, 1897.—Dr. G. S. Huntington read a paper entitled "A Contribution to the Myology of *Lemur bruneus.*"

The paper deals with some of the ventral trunk muscles and the appendicular muscles of the forelimb and pectoral girdle. A comparison of the structure of these muscles with the corresponding parts in other members of the suborder shows *L. bruneus* to possess marked primate characters in the arrangement of the pectoral girdle muscles and the muscles of the proximal segment of the anterior limb. This is especially evident in the lateral recession of the pectorales; the compound character of the ectopectoral insertion, the junctions of a pectoralis abdominalis with the typical entopectoral insertion, and the presence of an axillary muscular arch, derived from the tendons of the Latissimus dorsi and connected with the deep plane of insertion of the ectopectoral tendon.

The presence of a third or inferior portion of the coraco-brachialis is noted in addition to the upper and middle portion usually present in the Lemuroidia.

The ventral trunk muscles present a distinct carnivore type in their arrangement, instanced by the high thoracic extension of the rectus abdominalis, the occurrence of a well-developed supra costalis, the union of levator scapulæ and serratus magnus, the thoracic extension of the scalenus group—interlocking both with the serratus magnus and obliquus externus.

The aponeurosis of the obliquus externus presents a well-developed division of the internal pillar of the external abdominal ring, dovetailing with the one from the opposite side and forming the triangular ligament of the same.

Mr. H. E. Crampton, Jr., reported some of his " Observations Upon Fertilization in Gasteropods."

The observations were made upon the eggs of a species of Doris, collected last summer on the Pacific coast by Mr. Calkins, and upon a species of Bulla which deposited eggs at Woods Holl during the months of August and September. The results may best be summarized by stating that a complete confirmation was obtained of the accounts of fertilization given by Wilson and Mathews, Boveri, and Hill for sea-urchins, Meade for Chætopterus, Kostanecki and Wiejyewski for Physa, etc. The sperm nucleus is preceded by the divided centrosome ; an aster, however, not being found till the union of the germ-nuclei. The first polar spindle lies at each pole a double centrosome, the second maturation spindle but one. These are of great size, however, and the one remaining in the egg finally disintegrates, the centrosome of the first cleavage spindle being derived from the sperm. The germ-nuclei do not fuse, but lie very close to one another, in contact.

Mr. N. R. Harrington gave an account of the life history of Entoconcha, a mollusc parasitic in a Holothurian. His paper was illustrated by photographs.

The following paper was read by title: N. R. Harrington and B. B. Griffin, " Notes on the Distribution, Habits and Habitat of Some Puget Sound Invertebrates."—C. L. Bristol, *Secretary.*

Torrey Botanical Club.—At the annual meeting of the Torrey Botanical Club, held Tuesday evening, January 12, 1897, six new active and two corresponding members were elected. Resolutions of sorrow were adopted regarding the death of Mr. Wm. H. Rudkin, one of the oldest members, the discoverer of the hybrid oak *Quercus Rudkinii.* Annnal reports were presented by the standing committees and officers. It was resolved to print a list of the desiderata of the herbarium of plants growing within 100 miles of the city. The Treasurer reported a cash balance of $56.89 in the regular fund, and $514.14 in the Buchanan Fund.

The Recording Secretary, Dr. Rusby, reported an average attendance of 31 persons at the 15 meetings held during the year, 2 deaths, a net gain in active membership of 28, a present active membership of 219, corresponding membership 150, honorary membership 4, scientific papers presented 37, of which 22 had been published. Several hundred new species and a number of new genera had been communicated, and there had been a marked increase in the attention given to anatomical and cryptogamic subjects.

The Editor reported that Vol. 23 of the *Bulletin* had aggregated 548 pages and 34 full-page plates, and that two numbers of the Memoirs, aggregating 206 pages, had been issued. There was a cash balance from publications of $48.09 in addition to the balance already reported by the Treasurer.

The officers for 1897 were elected as follows: President, Addison Brown; Vice-Presidents, T. H. Allen, H. H. Rusby; Treasurer, Henry Ogden; Recording Secretary, Edward S. Burgess; Corresponding Secretary, John K. Small; Editor, N. L. Britton; Associate Editors, Emily L. Gregory, Arthur Hollick, Anna McVail, B. D. Halsted, Lucien M. Underwood; Curator, Helen M. Ingersoll; Librarian, William E. Wheelock.

The scientific program of the evening included papers by Mr. A. J. Grout and Dr. N. L. Britton.

In the first paper, "Notes on Some American *Brachythecia*," Mr. Grout compared the principles of classification employed by the two prominent bryologists, Schimper and Lindberg, and stated his reasons for preferring those of the latter to those of the former. He then exhibited and remarked upon four American species of *Brachythecium*, and expressed the opinion that they represent a genus distinct therefrom.

The paper will be published in full in the *Bulletin*.

Dr. Britton's paper was upon "*Linum Virginianum* and its Relatives." He illustrated the chief distinguishing characteristics of the species of *Linum* of the *Virginianum* group, and dwelt particularly upon the claims to specific rank of *L. Virginianum medium* Walter. —EDWARD S. BURGESS, *Secretary*.

American Philosophical Society.—February 5th.—This being one of the three meetings during the year at which special subjects are considered, the Committee on Programme selected "The Genesis and Chemical Relations of Petroleum and Natural Gas," and invited Professor S. P. Sadtler to open the subject. Professors S. F. Peckham, of Ann Harbor, Mich., C. F. Mabery, of Cleveland, O., and F. C. Phillips, of Allegheny City, Pa., presented their views from either the geological or chemical standpoint, or both. Profs. Edw. Orton and J. P. Lesley were also invited to participate in the discussion.

Biological Club of the University of Pennsylvania.—February 1st Program.—Original communication: "Account of the Boston Meeting of the Society of American Naturalists," Profs. Macfarlane, Conklin and Cope. Demonstration: "A Fossil Micro-fungus of the Coal Measures," Dr. J. M. Macfarlane. Reviews—Psychological, Dr. Lightner Witmer.—H. C. Porter, *Secrctary.*

The Ohio State Academy of Science held its winter meeting at Columbus, December 29th and 30th. The attendance and papers read show that this society is now well past the critical period of infancy. The Presidential address, by Professor Albert A. Wright, was an argument in favor of State coöperation with the U. S. Geological Survey for the production of a topographic map of Ohio. The proposal was heartily endorsed by the academy, and a committee appointed to take steps toward carrying it out.

Prof. D. S. Kellicott gave a list of ten fresh-water sponges in Ohio, with their localities; also, additions to his list of the Odonata of the State, bringing the number up to 94.

Additions to the list of Ohio phænogams, including altogether about twenty native and nearly as many introduced species, with new stations for other rare species, were given by Edo Claassen, of Cleveland; A. D. Selby, of the Agricultural Experiment Station; W. A. Kellerman, of the State University, and E. L. Moseley, of Sandusky.

"Additions to Ohio Fungi," by F. L. Stevens, gave as new to the list eight genera, eighty-five species, ten new hosts, and thirteen new localities. Fungi new to the State list were reported also by A. D. Selby and Edo Claasen.

E. L. Moseley reported a bird new to Ohio, the murre, *Uria troile,* whose occurrence on the Great Lakes has been doubted. Two were shot at Put-in-Bay, December 19th, and on the same day two near Sandusky.

Lynds Jones gave a detailed account of a grackle-roost on the college campus at Oberlin. The old males began coming to the roost at night, May 16th, while incubation was in progress; later, the females and young. The number during July, August and September averaged 6,000. Berries and green corn formed the bulk of the diet.

Prof. Claypole read a short paper on the Potato-rot Fungus, giving considerable evidence to show that the infection of the tubers from the parasite upon the leaves is not through the stem, but by the conidia falling to the ground and penetrating the tubers at the eyes.

"A Peculiar Case of Spore Distribution," by F. L. Stevens, cites with photographic evidence the distribution of spores of *Uncinula necator* by animal agency, probably a snail.

"An Anatomical Abnormality in the Human Hand," by E. W. Claypole, mentions a skeleton in which there were two scaphoid bones on both the right and left side.

"Os acetabuli," by Lynds Jones, describes this important secondary element of the os innominatum, which has been ignored by the majority of anatomists.

Gerard Fowke gave an account of archæological work in Pike County, and Warren K. Moorehead made remarks on a State archælogical map. Among the most interesting and important papers was one by Mr. E. E. Masterman, of New London, O., giving an account of the finding of a grooved stone axe, the material of which was profoundly oxydized at a depth of 22 feet in glacial drift or in the top of the boulder clay. The circumstances were such that every opportunity of mistake was apparently eliminated, and there seems to be no possibility of escaping the conclusion that the implement is a genuine relic of human workmanship which dates back to the later part of the ice age, when streams of water from the melting glacier deposited the sheets of gravel and clay which cover the plain of New London. Full details of the "find" have been published by Prof. E. W. Claypole in the November number of the *American Geologist,* to which the reader is referred.

Mr. Masterman exhibited also several other specimens, but none from so great a depth as the axe.

A list of Ohio Crambids was given by J. S. Stine, also a paper on "Museum Pests and Their Treatment," and one on "A Few Greenhouse Insects." E. W. Claypole presented a list of butterflies found in Summit County, and a paper on a peculiar katydid. Prof. Kellicott described a dragon-fly nymph from a thermal spring in California. Prof. F. M. Webster read a long and interesting paper on "Biological Effects of Civilization on the Insect Fauna of Ohio," and another on "The Protective Value of Action, Volitional or Otherwise, in Protective Mimicry."

Rev. H. Herzer gave a paper on "*Psaronius*," exhibiting a number of large specimens from the coal measures of Ohio.

Prof. E. W. Claypole gave an account of a stalagmitic deposit in the Carboniferous Conglomerate at Cuyahoga Falls, in which were found countless bones of a small tortoise, a few bones and teeth of the beaver, and some fragments of the skeleton of a deer.

Prof. W. G. Tight read papers on "The Preglacial Big Kanawha Drainage" and "A Preglacial Channel in Fairfield County." In a paper on "Huronite," by Prof. A. A. Wright, he proposed the use of the name "huronite diabase," as a petrographical term in tracing the distribution of boulders. "New Evidence Upon the Structure of Dinichthys," by A. A. Wright, was a resume of the evidence now existing as to whether the median element of the ventral armor of this Devonian fish consisted of a single plate only, as argued by Dr. Newberry, or of two plates, an anterior median and a posterior median, such as exist in Coccosteus, its British congener. In one species of Dinichthys indisputable evidence of *two* plates exists.

A key for identifying the land mollusca of Ohio was presented by Dr. V. Sterki.

The other papers read were: "A Simple Method of Inbedding Plant Tissues in Gelatin," E. M. Wilcox and J. W. T. Duvel; "Some Preservatives for Fresh-Water Algæ," Miss L. C. Riddle; "A Mode of Preserving Specimens for Class Use," E. W. Claypole; "Some Interesting Leaf Variations" and "Note on Cornus florida," Mrs. Kellerman; "Notes on Ustilagineæ," Aug. D. Selby; "A Hybrid Impatiens," F. L. Stevens; "Two Hydmuns," E. L. Fulmer; "Additions to the List of Exogens of Cayuhoga County," Carl Krebs; "Some Adaptations in Fungi" and "Comment on a Phase of Botanical Instruction," W. A. Kellerman; "Explorations of Norse Remains on Charles River, Mass.," Gerard Fowke; "How Do Glaciers Move?" John J. Janney: "Two Rare Fishes," Roy C. Osburn.

The academy appointed a committee to endeavor to induce the legislature to amend the game laws, and passed a resolution to be forwarded to Senator Sherman, protesting against the passage of the bill proposing to prohibit vivisection in the District of Columbia.

The officers elected for 1897 are as follows: Pres., W. A. Kellerman, Columbus; 1st Vice-Pres., Dr. C. E. Slocum, Defiance; 2d Vice-Pres., J. B. Wright, Wilmington; Sec., E. L. Moseley, Sandusky; Treas., D. S. Kellicott, Columbus. Executive Committee (elective members): L. H. McFadden, Westerville; W. M. Hill, East Liverpool.—E. L. MOSELEY, *Secretary*, Sandusky, Ohio.

Eleventh Annual Session of the Iowa Academy of Sciences.—The Iowa Academy in its eleventh annual session at Des Moines, Dec. 29th and 30th, 1896 enjoyed one of its most profitable sessions. The papers presented were as follows.

Prof. S. Calvin, "The State Quarry Limestone," discussed a series of limestone ledges in Johnson Co., Iowa, which are of Devonian(?) age and consist of comminuted parts of brachiopods, crinoids, etc., some of them deserving to rank as a brachiopod coquina. Its unconformability on the Cedar Valley limestone shows an erosion period not hitherto suspected in the Devonian and is evidently one of long duration. The fauna of the formation included the Devonian *Ptyctodus* and the subcarboniferous *Psephodes* among the rich fish remains and also brachiopods showing affinities to the carboniferous forms.

C. R. Keyes, "Stages of the DesMoines or Chiey coal-bearing series of the Kansas and southwest Missouri and their equivalents in Iowa," also, in conjunction with R. R. Rowley (read by title), "Vertical Range of Fossils at Louisiana."

A. G. Leonard, "Natural Gas in the Drift of Iowa" enumerates localities where natural gas occurs in the state and discusses its origin. Of the coal measures shales and the vegetable remains in the drift as possible sources the author concluded that for the Iowa localities the latter is the probable one.

J. L. Tilton, "Results of Recent Geological work in Madison Co." describes the geological formations of the county and discusses particularly the relation of preglacial to present drainage system.

G. E. Finch, "A Drift Section at Oelwein" described minutely an exposure recently brought to light in a railroad cut showing three distinct till sheets.

S. G. Beyer, "Evidence of a Sub-Aftonian Drift in Northeastern Iowa." Deduces from evidence at Oelwein, Albion and other points the extension of the Sub-Aftonian to this portion of the state.

T. H. Macbride, "The Botany of a Pre-Kansan Peat-bed" described recognizable plants occurring in the drift section exposed at Oelwein.

B. Shimek, "Observations on the Surface Deposits of Iowa" gave additional observations in support of his view presented at the last annual meeting of the Academy that the loess formation of western Iowa were of aeolian origin.

The same author in "The Flora of the Sioux Quartzite in Iowa," listed the species observed on this formation and discussed their relation to the flora of the other parts of the state, "Notes on the Aquatic Plants of Northern Iowa" also by the same author was devoted mainly to the flowering species occurring in ponds and lakes.

Bruce Fink in "Spermaphyta of the Fayette Iowa Flora" presented a list of about 700 species of plants collected for that locality.

T. Z. Fitspatrick, "Notes on the Flora of Iowa," a short list of species new to the state or but little known to its flora.

G. W. Newton, "The Mechanism for securing Cross fertilization in *Salvia lanceolata.*"

L. N. Pammel, "Notes on some Introduced plants in Iowa."

Emma Sirrine, "A Study of the Leaf Anatomy of some species of the Genus *Bromus.*"

Emma Pammel, "A Comparative Study of the Leaves of *Lolium, Festuca* and *Bromus.*"

C. B. Weaver, "Anatomical Studies of the Leaves of Certain Species of the Genus *Andropogon.*"

C. R. Ball, "Some Anatomical Studies of the Leaves of *Eragrostis.*"

The four papers above, gave extended details of anatomy bearing particularly on the value of such characters as means of separating species or varieties.

Gilbert L. Houser, "The Uses of Formaldehyde in Animal Morphology." Advantages and disadvantages; uses in Neurological work, also in "The Nerve cells of the Shark's Brain" discussing morphological importance, features of structure, and details the results reached by use of the Golgi method.

L. S. Ross read three papers "Some Manitoba Cladocera with Description of One New Species." "A New Species of *Daphnia*, and Brief Notes on Other Cladocera of Iowa." "The Illinois Biological Station."

F. A. Sirrine, (by title) "The Probable life-history of *Crepidodera cucumeris.*"

Charles Carter, of Fairfield discussed the Odonata of Iowa in some preliminary remarks and requested correspondence on the group.

E. D. Ball, "Notes on the Orthopterous Fauna of Iowa."

A. H. Conrad, "The Ophidia of Iowa" remarked on the changes in the fauna of the state and the desirability of a prompt study of the group.

Herbert Osborn, "Additions to the Hemipterous Fauna of Iowa" lists of number of species not hitherto recorded.

In Business session, among other items, resolutions were passed opposing anti-vivisection laws in the District of Columbia and a subscription was voted to the Pasteur Monument Fund.

The following officers were elected for the coming year:

W. S. Franklin, President; T. H. Macbride, Vice-President; B. Fink, 2nd. Vice-President; Herbert Osborn, Secretary and Treasurer; L. S.

Ross, J. L. Tilten and C. C. Bates to serves with officers as elective members of executive committee.—HERBERT OSBORN, *Secretary.*

Botanical Seminar of the University of Nebraska.—January 16.—At the regular monthly meeting. De Alton Saunders presented a paper upon "The Relations of the Laboulbeniaceæ to the Red Seaweeds," illustrated by blackboard sketches of their structure.

January 23.—This adjourned meeting was devoted to a Symposium upon "Systematic Mycology" led by Roscoe Pound, who spoke first upon "The Relation of Morphology to Classification" and then upon "Schrœter's Arrangement considered as a Modification of the Brefeldian Arrangement." Hs was followed by Dr. Bessey on "The Natural Arrangement of the Fungi," and F. E. Clements on "Suggestions for a Re-arrangement of the Higher Fungi."

SCIENTIFIC NEWS.

A PROTEST.—I am sure that I voice the opinions of a large number of naturalists when I protest against a tendency very strong in some localities to rename things already well named. It would even appear to an outsider that these persons must think that by this introduction of new names they were greatly advancing science. To me it seems that they must be clogs to the wheels of progress. One must needs know a double or even a triple nomenclature to read their papers intelligently, and this learning of these new names is, as Col. Lyman has expressed it, "like saw-dust swallowing, neither palatable nor nutritious."

As an example of what I mean I may cite the article on "Formal" in the January number of THE AMERICAN NATURALIST. We are told there that "the term formaldehyde is a cumbersome one" and "formal" is suggested as a substitute. Shall, therefore, every cumbersome name be discarded? Do not the constituent parts of the name mean something? Is not the name of the sea-urchin of northern New England—*Strongylocentrotus droebachiensis*—cumbersome? Must we, therefore, change it?

If we must change the names of these substances, of these things, because of their sesquipedalian names, let us take some pains with the substitutes proposed. Formal for formaldehyde is unfortunate. Formaldehyde has the formula $H\text{–}CHO$. By the rules of chemical nomenclature the term "formal" would mean a compound like acetal, one which would have the formula $H\text{–}CH\text{–}(OE)_2$ and hence the endeavor to get rid of a cumbersone term introduces a worse confusion. It is, to quote Waterhouse Hawkins' pun, bewildering.

—A COMPARATIVE ANATOMIST.

Again we are to use the term formal for formaldehye both for this substance itself and for its solution in water. Is this not adding to confusion? Formalin, we are told is a term which has no meaning. From the standpoint of chemical terminology this is true but from another standpoint it is not. It is an arbitrary term introduced into the language to denote a forty per cent. solution of formaldehyde in water and as such it has a distinct meaning and, on the ground of convenience, a very great value.

In the same article are other illlustrations of just this same tendency against which I protest. There are incidentally mentioned axon, alba, tela, and the like and one trained in the nomenclature of universal use has to refer to a large series of papers in order to ascertain just what is meant by all of these expressions. I can see no reason why the term notochord is not good enough for anyone; it is descriptive, and it has but a single meaning which cannot by any possibility be confused. How about its proposed substititue "axon" I have not taken the trouble to look up the reasons for substituting this term. On its face it would seem to imply something pertaining to the axis (of the body). But is the notochord really axial? As far as the vertebral centres are concerned it is, but beyond this it is not, and to just this extent it is a misnomer. So far as any higher metazoan may be said to have an axis, that axis is the alimentary tract.

These I merely instance as examples of what I protest against. The terminology of modern zoology is sufficiently overloaded already with terms and this attempt so persistently made in certain quarters to give us in addition an almost complete series of synonyms is most aggravating. I would suggest to these would be reformers that there is no little truth in Goethes' lines when he says that reality " ist alles

" Name ist Schall und Rauch.
Umnebelnd Himmelsgluth.

COMPARATIVE ANATOMIST.

Emil du Bois-Raymond.—The well known physiologist, professor of physiology at the University of Berlin, founder of the Physiological Institute, and perpetual Secretary of the Berlin Academy, died December 26th after a severe illness. Prof. du Bois-Raymond was born, November 7, 1818 in Berlin, where his father, who had begun life as a match maker, had attained considerable eminence. His early education was received at the College Français in Berlin and later at the College of Neuchatel. At the age of eighteen he entered the University of Berlin and was matriculated in the Philosophical Faculty.

At first he was much interested in electricity and attended the lectures of Neander. But about 1837 he took up seriously the work in which he became so well known. After some time spent with mathematics, physics and chemistry, he began studies under J. Müller, and somewhat later became his assistant.

His being asked in 1841 by Müller to repeat the observations of Matteucci in his essay "Sur les phénomènes électriques des animaux," published at Paris a year previously, led to the historical studies that he embodied in his dessertation for the degree of D. M. (Quæ apud verteres de piscibus electricis extant argumanta "), and to the discovery of the main facts of modern electro-physiology. In 1858 he succeeded Müller as Professor of Physiology at Berlin, and in 1867 was chosen secretary of the Berlin Academy. As a result of his forethought the Berlin laboratory became the model for similar laboratories the world over, for the plans upon which the palatial building in Neu Wilhelmstrasse was erected after the Franco German war, were of his designing.

His papers are numerous, but his great work is that "On animal electricity," the first volume of which appeared in 1848 and the last only about ten years ago. In 1878 he published his "collected papers," which comprise all of his scientific work done up to that time except what had been embodied in his "Thierische Elektricitat." The historical introduction contained in the first few chapters of his "Animal Electricity," his essay on university organization (1870), that on the present and the past of physiological teaching, and on the relations of natural history to natural science (1878), that on the limits of natural knowledge (1882) are well known.

The real greatness of the man consisted, not in the theories that he put forth, but in the exactitude of his observations, the excellence of his methods, and the large number of new relations that he discovered between physical and vital phenomena. As Ludwig taught the world how to investigate the mechanics of the circulation, and as Helmholz how to determine the time-relations of physiological processes of very short duration, du Bois-Raymond not only opened a new field for investigation, but also furnished the means of working it.

Like other great teachers he founded a school, and if his pupils were not so numerous as those of some other greater teachers, they occupy very important academical positions. (See "Nature").

Prof. Francis E. Lloyd, who now holds a position in the Pacific University, Forest Grove, Oregon, has been appointed professor of biological science in the Teachers College.

The Danish Paleontologist, Henrik Julian Posselt, died July 20, 1896. He was connected with the museum in Copenhagen and was a student of Molluscs and Molluscoids.

Dr. Stuhr goes to the University of Breslau as assistant in the Anatomical Institut, in the place of Dr. H. Endres who went some time ago to the University of Halle.

Dr. N. Tschermak, of St. Petersburg, succeeds Prof. Barfurth as professor of comparative anatomy and embryology in the University of Dorpat.

Mr. Fernand Latush calls the attention of correspondents to the fact that his present address in Cadellac-sur-Garonne, Gironde, France.

Dr. Auguste Louis Brot, conchologist, died Aug. 30th, at the age of 75; for forty years, he was connected with the museum at Geneva.

Dr. V. Goldschmidt has been advanced to the position of professor extraordinarius of mineralogy in the University of Heidelberg.

J. C. Willis, formerly assistant in botany in the University of Glasgow, has gone as Director to the botanical garden in Ceylon.

Professor F. Jeffrey Bell has resigned his position as professor of comparative anatomy in Kings College, London.

T. S. Hart, of Melbourne, is appointed tutor in geology and botany in the School of Mines, Ballarat, Australia.

Dr. Theodor Margo, Professor of zoology in the University of Budupesth, died Sept. 5th, 1896, aged 80 years.

Dr. A. V. Fomin has been appointed assistant in the botanical garden of the University of Dorpat.

N. Rüdinger, professor of anatomy in the University, of Munich, died Aug. 25, aged 64 years.

Dr. N. Andrussow, of St. Petersburg, takes the chair of geology in the University of Dorpat.

Dr. Jensen was recently appointed privat-docent in physiology in the University of Halle.

Dr. R. Zander, assistant in botany in the agricultural school in Berlin, died Sept. 10.

Dr. F. Tognini is now conservator of the botanical garden of the University of Pavia.

Th. Hick, instructor in botany in Owens College, Manchester, is dead, at the age of 56.

Dr. Fritz Westhoff, privat-docent in the Akademie of Münster, died Nov, 11, 1896.

Dr. v. Dungern is now docent in bacteriology in the University of Freiberg.

Dr. Braus is now privat-docent in zoology in the University of Jena.

Maurice Chaper, Malacologist, died in Paris July 5, 1896.

L. Rudolph, botanist, of Berlin, is dead at the age of 83.

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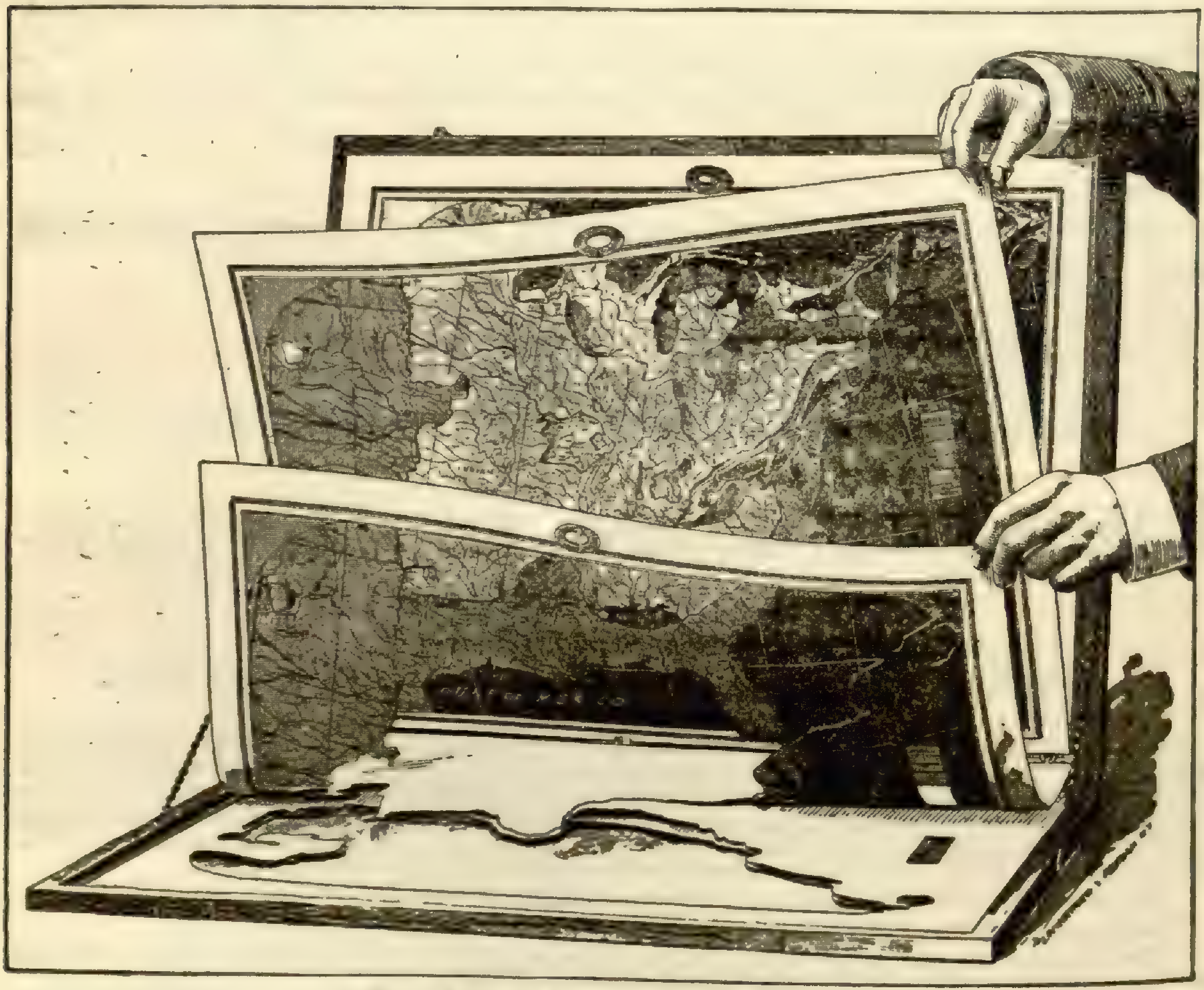

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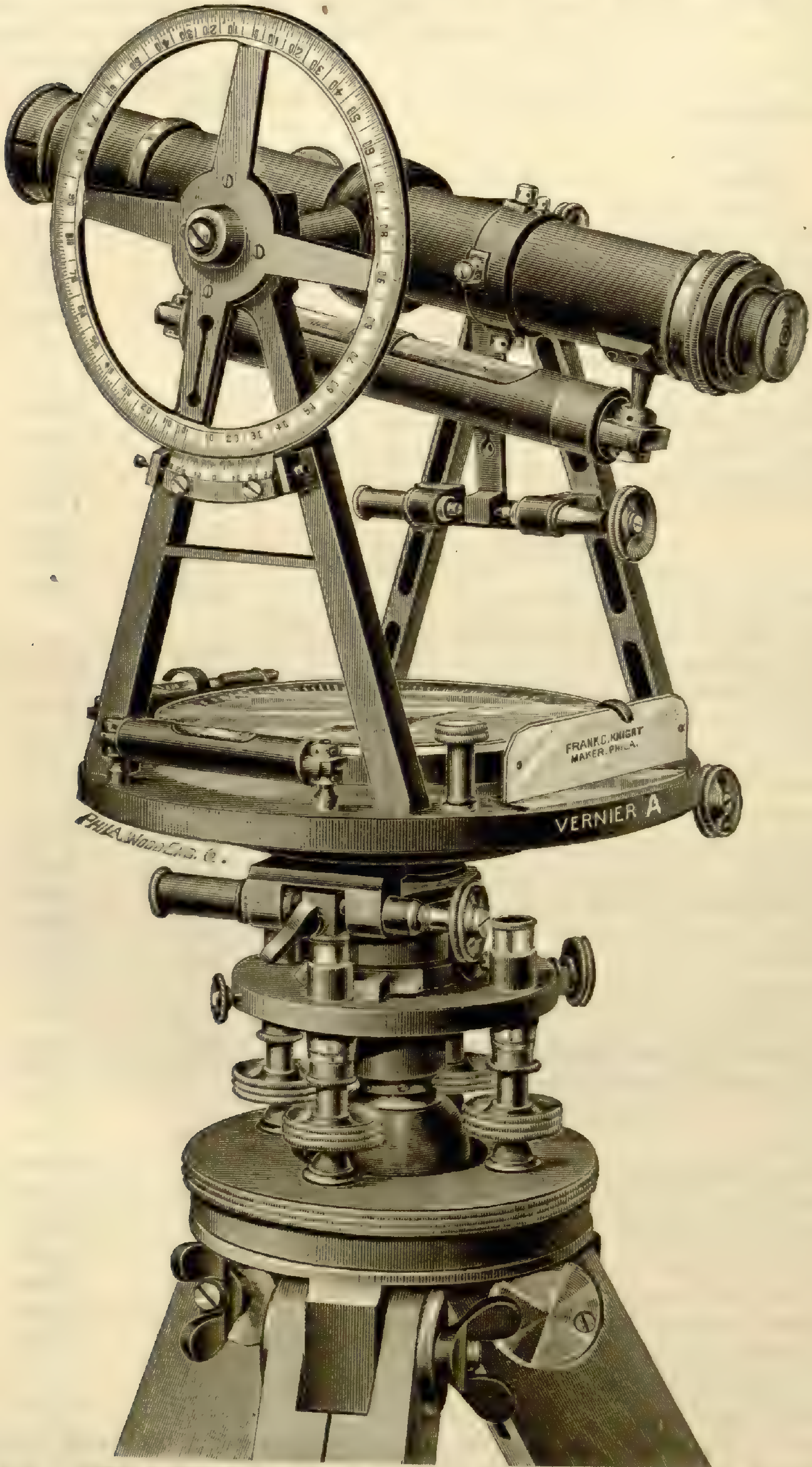
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THE SCOPE AND PRESENT POSITION OF BIO-CHEMISTRY.

BY ALBERT MATHEWS.

The practical value of pure science is now so generally recognized that no excuse need be given for a plea on behalf of a neglected department. Especially is this true of a department which so closely concerns our bodily welfare as does physiological, or bio-, chemistry. This science has not received in America that recognition and support which its importance as an applied or pure science would warrant. This may be due, in part, at least, to a failure to realize that to biochemistry belong problems outside the scope of any other science ; it may, therefore, not be out of place to indicate briefly what some of these problems are, and to what position, in the world at large, this new science has now attained.

Although it is impossible to define sharply the limits of a science it may be said, in a general way, that to biochemistry belong all problems of the chemistry of living matter, or of the chemistry of metabolism. It is thus the complement of the group of sciences treating of the forms and relationships of organisms, botany and zoology, and of the mechanics of organisms, or physiology proper. Touching each of these sciences closely, it receives from each special problems for solution.

Among the more important problems of plant biochemistry are the chemical nature of chlorophyll, the nature and manner of action of the starch-forming substance, the determination of the substances out of which the plant synthesizes its protoplasm, and the nature of this synthesis. In bacteriology the biochemist has a wide field for work. The isolation of the specific immunizing substance in the antitoxins of diphtheria, tetanus and other cases of artificial immunity, is a matter of great practical importance. There is pressing need of a chemical examination of the bacteria and their products, whether poisonous or not. The determination of the active substance in such bodies as the tubercle bacilli, which cause cell proliferation, is an interesting matter which might have a considerable practical value.

In physiology, biochemistry has hitherto played its chief rôle in the study of excretion and digestion. The results obtained have thrown light on the functions of many organs. An interesting question of physiology at the present time is that of the internal secretions of glands. It is becoming increasingly probable that these form an important element in the coördination of the organism, one organ or gland forming and throwing back into the blood substances essential to the life of some other organ. The determination of these substances, of such preeminent importance to the organism, is a biochemical problem. The isolation of the contractile substance in muscle, the chemical changes undergone by muscle and nerve during activity, the nature of the irritable substance of the nervous system, are puzzles which fall to the biochemist. Our knowledge of the chemical constitution of the fluids and tissues of the body in health and disease is derived from this science.

In the province of biology the ultimate aim, however distant the goal may be, is the analysis and synthesis of living matter itself. The explanation of the formation of new protoplasm will probably come from the biochemist. He must isolate and examine the various substances in the cell. That this field is full of promise is evident from the results already obtained. Morphology, too, furnishes its quota of problems. The influence of certain substances upon embryonic development is in part chemical. We are now familiar with the progressive differentiation of organs from the egg, but of the nature of the chemical differentiation which this structural differentiation implies little is as yet known. Whether the chromatins of the cells derived from the egg are different from that of the egg-cell, and in what way, is a question of theoretical interest to be answered definitely only by biochemical research. The determination of the chemical nature of the substance causing cell division, karyokinesis, of the substances formed, and of the nature of the changes undergone, is essential to the understanding of this process. The answer to these questions may be of value in the explanation of tumors and other pathological growths involving karyokinesis.

Biochemistry has perhaps its chief practical worth in medicine. The physician it serves not only indirectly through the solution of physiological and bacteriological problems, but directly in testing the action of drugs and diets upon metabolism, and in the careful study of the urine and blood in health and disease. The physician is thus given an accurate means of diagnosis in certain diseases. An interesting result accomplished recently in this direction has been the discovery of the origin of uric acid, a substance of considerable pathological interest, in the chromatin of the cell-nuclei, and thereby a possible explanation is given of the action of quinine, antipyrin, and antifebrin, in decreasing the secretion of this substance.

Another practical biochemical problem important in medicine is the isolation from glands and other organs of their so-called "internal" secretions already mentioned. Hitherto, in treating myxœdema, goitre, or Addison's disease, by the so-called extract therapie, physicians have used either the whole substance of the thyroid, or thymus glands and the suprarenal capsules, or extracts of these organs—a process which introduces useless as well as healing matter. It would be advantageous to use the pure remedial substance alone. In one of these organs this is now possible, two biochemists having recently isolated the healing substance from the thyroid gland so that it is now prepared pure for the physician. It is not too much to hope that similar substances will be isolated from other glands and organs, and that the physician of the future will be able partly to maintain the metabolic equilibrium of the body, or to restore that equilibrium when disturbed, by supplying the missing substances.

The composition of the yeast-cell, its metabolism when fed on different substances and under different conditions, the determination of the sugars which it will, or will not ferment, and the isolation of its special ferments, are problems important for the brewer, the winemaker and the baker.

The questions thus brifly indicated form a well-defined group. They constitute the problems of one science. Many of these problems cannot be satisfactorily dealt with either by the organic chemist alone or the physiologist alone. The biochemist needs both a theoretical and practical knowledge of animal and plant morphology and physiology, which is largely superfluous in the analysis and synthesis of the great majority of organic substances. On the other hand these problems cannot be left to the physiologist, for few physiologists have the time or opportunity to acquire the necessary chemical knowledge. Even pure physiology alone is so broad that one is rarely found thoroughly familiar with more than a portion of it.

It is for these reasons desirable that the independent position of biochemistry should be recognized, and equipment and means provided for its development. And it is an encouraging sign of the times that so eminent an organic chemist as Emil Fisher, has recently spoken strongly for the independent position of biochemistry.

In Europe, largely owing to the winning personality and untiring labors of the late Felix Hoppe-Seyler, the science is now beginning to receive recognition. The modern science of biochemistry, indeed, may be said to have been founded by this illustrious man; for, although previous to him work had been done in a biochemical direction by chemists, physiologists, agriculturists, and others, he was the first to urge the independent position of this science. An Institute and Professorship of Physiological Chemistry were established for him at Strassburg. He founded a journal in which papers treating of biochemical matter could appear, and thus brought to a focus a number of lines of effort which had formerly been scattered in chemical, physiological and agricultural publications. The founding of the Strassburg Institute and Professorship was the official birth of biochemistry.

But, although great progress has been made since Hoppe-Seyler opened his first laboratory in the kitchen of the old castle in Tübingen, the position of the biochemist in Germany is still behind that in many other European countries. The Strassburg Institute remains the only purely biochemical institute in Germany. In many German universities the biochemists are nominally full professors of physiology, as in Heidelberg (Kühne), Marburg (Kossel), and Munich (Voit); in others, besides the full professor (ordinarius) of physiology there is an associate professorship (extraordinarius) in physiological chemistry. This is the case in Berlin (Thierfelder) and Breslau (Röhmann). In still others the professors of pharmacology take over the duties of the biochemist, as in Rostock (Nasse), Königsberg (Jaffé), Giessen (Gähtgens) and Halle. In Tübingen the physiological chemist is called professor of applied (angewandte) chemistry, and belongs to the philosophical faculty; in Freiburg he is professor of chemistry and belongs to the medical faculty; in Leipsic he is a privat docent (instructor) in the physiological institute. In the universities of Göttingen, Kiel and Würzburg there is no special instruction in this science. In Germany, therefore, although the science is recognized in nearly all universities, and its teachers in many cases full professors, they are generally handicapped by being required to teach chemistry, physiology, or pharmacology.

Outside of Germany the situation is generally more favorable. In Austria the universities (Prague, Vienna and Gratz) have professorships in medical chemistry. In Switzerland there are professorships of physiological chemistry in Basel (Bunge) and Berne (Drechsel). At Zürich there is none, though a good deal of work is done in the agricultural chemical laboratories. In Norway, at Christiania, there is no chair of physiological chemistry. In Russia nearly all the universities—Moscow, St. Petersburg, Warsaw, Kieff, etc.—have chairs of physiological chemistry. In Galicia such professorships are established in the universities of Lemberg and Krakow. In Italy and France, as far as I can learn, there are no such professorships, but accurate information is lacking. In Sweden, at Upsala, the biochemist Hammarsten is Professor of Physiological and Medical Chemistry. At Stockholm there is also a professorship in this science, as well as in Lund. It all these cases, it will be understood, there are separate professorships in physiology. In England there are no professorships of biochemistry. The biochemist Halliburton is Professor of Physiology in Kings College, London. In Cambridge University, in the extensive laboratories of Professor Michael Foster, considerable space is devoted to biochemistry under the direction of Dr. Sheridan Lea.

In Germany there is one magazine, "Die Zeitschrift für Physiologioche Chemie," devoted entirely to this science. About four-fifths of the "Zeitschrift für Biologie," one-fourth of Pflüger's "Archiv für die gesammte Physiologie," nearly all of Schmiedeberg's "Archiv für experimental Pathologie u. Pharmakologie" consist of biochemical papers. Many papers also appear in Virchow's Archiv, in the Bacteriologische Centralblatt and various other scientific publications.

In England the "Journal of Physiology" contains a greater or less number of biochemical articles—but there is not in the English language any magazine devoted exclusively to this science. Nor is there any American Journal of Physiology in which biochemical papers could appear. The English Journal of Physiology is the only journal which will give physiological and biochemical papers a general circulation. It is unfortunate that so large a proportion of physiological papers from American laboratories should be driven to the German journals and language. This is the more to be regretted since the history of the Journal of Morphology teaches that an American physiological journal, publishing papers of a high class, would have an assured circulation among European scientific men.

We, in America, are in a backward condition when compared with Germany, Russia, Sweden and Switzerland. Biochemistry in America has suffered, like physiology, from being confined to the medical schools. Here both have been treated too largely as applied sciences. Both would greatly profit in being taken from the medical schools and established, like physics or chemistry, in separate institutes where both the pure and applied science should be taught. The biochemical laboratory should be one of the laboratories of the university, just as the laboratory of experimental physiology, or organic chemistry. It should be in the hands of investigators, and should give instruction not only in urine analysis, but in the principles of metabolism. For the purpose of mutual helpfulness it should be in close connection with the laboratories of experimental physiology and organic chemistry. It is greatly to be hoped that the progress of this science in America may be furthered by the establishment of professorships of biochemistry and of an American Journal of Physiology and Biochemistry to provide a ready means of publication for physiological and biochemical papers.

THE POLYPHYLETIC DISPOSITION OF LICHENS.[1]

BY FREDERIC E. CLEMENTS.

The present trend of thought upon the morphology and disposition of the lichens must be most encouraging to those, who stood at first alone, and then with ever-increasing company, for the complete acceptation of the Schwendenerian hypothesis, and of the morphologic and phylogenetic theories involved in it. Even during the present decade, botanical literature has not lacked for articles, penned chiefly by lichenologists, disproving in its entirety the algo-lichen theory, and maintaining the autonomy of the lichens, as they are pleased to term it. When the "symbiosis", "consortism," or parasitism of lichens was established beyond a doubt, and polyphylesis was postulated as a necessary consequence, the lichenographers again rose en masse, arguing and pleading for the dignity and autonomy of their group. Since the tacit and universal acceptance of the polyphyletic origin of the lichens, opposition to their distribution among the other fungi had practically ceased, until the revival of the question by Reinke's articles published during the past year or two.

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[1] Read before the Botanical Seminar of the University of Nebraska. December 5, 1896.

To the Seminar, which has stood since its inception unqualifiedly for the Schwendenerian theory, and for the consideration and treatment of all fungi as fungi, my task will seem a gratuitous one. It may not be, however, entirely unprofitable to consider in detail the arguments still advanced by some botanists against what is here regarded as the ultimate disposition of the lichens.

In addition to Reinke's rather exhaustive papers, Gregory and Schneider have written short articles, chiefly recapitulatory of Reinke's views, and hence of little import, were it not for the fact that the first endeavors to throw the weight of Schwendener's half-expressed disapproval to her side of the question. Reinke's articles, however, form the rallying ground of all those fearful of the degradation of the autonomous dignity of the lichens, and will alone be discussed here. His conclusions are based upon serious work, and, in consequence, deserve earnest consideration, although not infrequently ridiculous to one free from the trammels of "consortism," "mutualism," etc.

The greater portion of Reinke's arguments are given in his second paper (Pringh. Jahrb. 26: 524, 1894). In the prefatory remarks to his fifth article (Pringh. Jahrb. 29: 171, 1896), which treats of the natural lichen-system, he adduces certain general arguments that have equal weight on either side, and makes some specific objections that have little relevancy and less significance. In consequence, the following discussion will be limited chiefly to the second paper, the more important points of which will receive successive treatment.

"Concerning ascolichens, it may be postulated that the component fungus no more exists, probably never existed, in the free state." Since lichens are lichens, and, according to Reinke, every lichen a "consortium," whether its fructification be by means of asci or by basidia, he begs the question in limiting his statement to ascolichens. In complete refutation of this, I might then cite Moeller (Flora 77 : 253, 1893), who shows conclusively that the thelephoroid fungus represented by the three lichen genera, *Cora*, *Dictyonema*, and *Laudatea*, may be, at the same time, a saprophyte, or a parasite upon two different genera of algæ, *i. e.*, a facultative parasite. For the ascolichens, Reinke contradicts his own statement that their fungal prototypes no longer exist (Pringh. Jahrb. 28 : 71, 87, 135, 1895). The mere fact that he has been obliged to divide the genera *Calicium*, *Bilimbia*, *Bacidia*, *Placographa*, *Melaspila* and *Arthonia* into a series of lichen genera corresponding respectively to the above, and a series of " myco-genera," *Mycocalicium*, *Mycobilimbia*, *Mycobacidia*, etc., solely because certain fungi, having parasitized accidental algal cells, have lost their saprophytic habit, is conclusive. It is also admitted by the best mycologists that *Biatoridium*, *Lecidea* and *Buellia* can be distinguished from *Biatorella*, *Patinella*, and *Karschia* only through what can be called scarcely more than incipient parasitism. More than this, *Buellia myriocarpa*, as Reinke himself admits (Pringh. Jahrb. 28 : 93, 1895), is sometimes provided with gonidia, sometimes lacks them. It is then either a fungus or a lichen. This species is certainly a remarkable one, in that it belongs to two different and distinct subkingdoms, or at least classes! Were cumulative evidence needed, the repeated artificial synthesis and analysis of lichens would be more than sufficient to discredit Reinke's statement, notwithstanding his inability to appreciate the weight of these facts.

It is a scientific truism that phylogeny is the science of probabilities. No thoughtful scientist should dream of demanding absolute proof in general phylogenetic problems. In discussing questions of phylogeny, when the ultimity of probability is reached, except in the rarest cases, argumentation must cease. As for hymenolichens, we may regard Moeller's careful researches as, comparatively speaking, absolute proof of their direct and recent derivation from the *Thelephoraceæ*. For the ascolichens, enough has been said to demonstrate the conclusion toward which extreme probability points.

" The attempts at the distribution of the lichens have been of an unsatisfactory nature." It is by no means true that, to know the need of a reform, one must know how to bring such a reform about. If the method of reformation, or of rearrangement is hard to discover in those matters in which the factors are well-known and can be carefully weighed, how much more difficult is it where phylogeny with its undiscovered and undiscoverable quantities complicates. May we not, then, be pardoned if we consider Reinke's criticism of Von Tavel's endeavor to distribute the lichens as essentially puerile, and of negative weight in serious discussion?

"Taxonomy should, moreover, follow practical lines." It has been generally supposed that the constant endeavor of taxonomy during the past century has been to rid itself of the burden of practicality. If, as Reinke suggests, attempts to discover the phylogeny of any plant-group must always be unfruitful to a great extent, then a practical system, not a theoretical one, is a desideratum. If this is true, it is both remarkable and unfortunate that the best botanical effort of decades past has been directed to the replacement of artificial systems by natural ones, and to the improvement of the latter. As a matter of fact, such is not true. Taxonomy is, ultimately, never a means, but an end, and the demands of practicality in a system are entirely without force, until those are fully met which are entailed by the departments of botany that true taxonomy should summarize. Thus, the rapidity with which a system may be leaved over, is no index of its value. In fact, natural systems are necessarily complicated, and great convenience and "usability" in any system are in themselves suspicious. Reinke laments the fact that the lichens have disappeared so suddenly from a prominent place in texts, that it often involves trouble to find them in "anhänge" to different fungus-groups. Likewise, it would require less manual labor if the lower cryptogams were still grouped as algæ and fungi, and, from the same point of view, it is a great bother to follow an apetalous family into some obscure nook among the *Choripetalæ.* Yet there are those who prefer an expression of probable phylogenetic relationship in a system to mere utility, and, who, unlike Reinke, have no "misgivings as to the fitness of arranging a great plant-group, so rich in forms and numbers as the lichens," in "anhänge," until a better disposition is possible.

The lichenologists, the specialists in this branch, "have intuitively opposed the "sidetracking" of the lichens." I mention this argument of Reinke's merely to show the peculiar cogency so characteristic of his article. It would not have been inopportune to cite the particularly felicitous, intuitive opposition of lichen-specialists to the Schwendenerian theory. But the author, naively, states that, while he has sympathised with this later stand of lichenologists, it was unfortunate that their weapons were directed against the Schwendenerian theory.

"In the form and structure of their vegetative organs, the lichens are closely connected with the other green, chlorophyll-bearing plants." If it were worth while to discuss this question, it might be readily shown that the only resemblance in form is a superficial one, due to parallelism, while the other great similarity arises from the fact that the one possesses assimilative power in and of itself, while the other appropriates that inherent in another organism. It is useless to press this point, however, since it is directly dependent upon whether the lichen is regarded as a instance of parasitism, or of "consortism."

Reinke, apparently, labors constantly under the delusion that those who contend for the distribution of the lichens, deny their polyphylesis. Contrariwise, they were the first to postulate and to establish it. All are in accord that, while the lichens originated from the fungi polyphyletically, this origination occurred at comparatively few points, and that the modification and specialization of these phylogenetic lines took place after the fungus had become parasitic upon an alga. No one who traces the lichens back to the fungi would for an instant maintain that each lichen family finds its prototype among the fungi. But, on the other hand, one must insist that at those points where fungi passed into lichens, an almost perfect series of gradations is noted, and that phylogenetic and morphologic continuity are complete at these places.

Naturally, the chief argument of the author is that the lichen is not a parasite, but a "consortium." In direct contradiction to this, as Reinke himself admits, is De Bary's statement that the fungus occasions considerable change in the host, the alga. Reinke is unable to evade this, but prefers to interpret it as an advantageous adaptation due to the synthesis of fungus and alga to form a "consortium." Then, in like manner, the increased rapidity of division, and the great distension of the cells of an elder leaf, occasioned by the presence of æcidial filaments, are adaptations traceable to incipient "consortism," if you wish, parasitism, in reality. The mere fact that the histogenetic relations of the cells in a tissue are not such that continuous multiplication of cell-individuals is possible, as is the case with free algæ, has no significance. The tissue-cell and the free alga exhibit essentially the same biological behavior when parasitized. The only difference is that, in the one case, cytogenesis fixes a limit, in the other, it does not.

In many cases, moreover, parasitism effects little or no change in the tissues. This is notably the case in Erysipheæ, in many Peronosporaceæ, and Uredineæ. On the other hand, algal cells often become so completely involved in hyphal threads that division is impossible, when the existence of real parasitism is quickly demonstrated.

The significance of the soridium and of hymenial gonidia is regarded by Reinke as very considerable. To me, both, but the soridium especially, are mere modifications of the fungus due to changed habit, and contingent upon incipient or advanced desexualisation. The significance of either, were they universally present, would be neither profound, nor otherwise inexplicable. The fact that they occur almost wholly among forms possessing a thallus of a considerable degree of development, and the fact of their utter absence in the primitive types is sufficient proof of their lack of meaning. Of equal weight is the presence of lichenin. The elementary condition of our knowledge of microchemistry should deter anyone from generalizations derived therefrom. Reinke's statement concerning the characteristic presence of many chemical substances is essentially one of the antiquated arguments of the lichenologists, and is scarcely more valid than that one in which, speaking of the discriminative powers of certain genera of insects, which feed upon lichens, and not upon fungi, Cooke says: "These insects must have come to a sounder conclusion than some men, viz., that lichens are not fungi with the addition of an innocuous green alga."

The most curious error of Reinke's is made in explanation of Moeller's researches upon *Hymenolichenes.* The author says frankly that after reading Moeller's article he asked himself if its conclusions were contrary to his opinions. At the same time, he affords an instructive illustration of how the interpretation of a fact may entirely controvert its meaning. If one were to find a facultative parasite growing at the same time on the ground, and upon two different host-plants, the explanation would be so obvious that one would not waste a thought upon it. The fact that the saprophyte exists alongside the parasite, the lichen, would mean simply that here was the starting-point of a phylum. Not so with Reinke. To him the occurrence of *Cora* as a facultative parasite signifies that here is a fungus, which forms "consortiums" with different algæ, a proof, as he takes it, that the fungus alone is insufficient for the thallus-body. Also, a proof in my mind that a host is indispensible to any parasite. As for the occurrence of hymenomycete and hymenolichen together, Reinke considers this entirely analogous to the concomitant appearance of alga and lichen, and, as I have pointed out above, this is true, since it involves nothing more than the simultaneous occurrence of a saprophyte, its host, and the same saprophyte in the role of a parasite.

I have taken up the above arguments in detail merely to demonstrate the little bearing they have upon the question. In determining relationships, phylogeny alone has value; histogeny, morphology, and physiology are useful only so far as they can furnish data respecting the probable phylogeny. I have already said enough to show that I appreciate the exceeding difficulty of retracing phylogenetic results. Happily, in the lichens, the phyletic lines are comparatively short; this is especially true in the hymenolichens, where the developmental processes are going on before our eyes. On the one side is the indubitable fungus ancestor, the thelephora; on the other, the two direct descendants, *Cora*, and *Dictyonema*, incipient phyla, whose future directions of development are foreshadowed in the *Laudatea*-forms.

The ascolichens were derived from the *Ascomycetes* at an earlier period, and their great specialization and the interval of time elapsed have to a considerable degree obscured the points of departure. But, as has been pointed out above, the "fungo-lichen" genera, *Calicium, Bilimbia, Bacidia, Placographa, Melaspila, Biatorella-Biatoridium, Patinella-Lecidea, Buellia-Karschia, Graphis-Hysterium*, and the species, *Buellia myriocarpa*, leave little doubt concerning the derivation of their corresponding families. They simply await the thorough investigation given hymenolichens by Moeller. If we are to consider only the highly specialized ends of phylogenetic branches, we should all be constrained to admit that lichens must receive treatment as a group. But, in such an event, we should do the greatest violence to phylogenesis as the determinant in taxonomy, in making lichens coördinate with algæ and fungi, merely on the basis of a physiological character. I admit that there could be a class, or a branch, *Lichenes*, based upon this physiological character, or perhaps upon morphological characters induced by adaptation to assimilation-processes. So, also, might there be a group, *Parasiticæ*, coördinate with *Phanerogamæ*, which would include such closely related genera as *Cuscuta, Razoumofskya, Phoradendron, Thalesia*, etc. Such is the logical result of Reinke's opinion that a more or less constant physiological character, for lichens, "consortism," obtains for the delimitation of great groups, in spite of the significant evidence of phylogeny.

Summarizing: Reinke's conclusion that lichens are physiologically and morphologically distinct from fungi is untrue, and his statement that it is impossible, on account of certain physiological characters, to distribute them among fungi is equally unwarranted.

FOSSILS AND FOSSILIZATION.

BY L. P. GRATACAP.

(*Continued from page 199.*)

There are many facts in chemistry which show that there can be mutual displacements in solutions of various substances, although there is also a series of facts that prove the additional solubility of insoluble salts in the presence of other salts or in dilute solutions. Thus, when certain salts, dissolved in a small quantity of water decompose one another by double interchange of bases and acids, producing a precipitate of a difficultly soluble salt, no precipitate occurs in more dilute solutions, although the quantity of water present would not be sufficient to hold in solution the less soluble salt, which may be produced by the decomposition, if it existed in the separate state. For example, sulphate of lime requires about 400 parts of water to dissolve it; but chloride of calcium, dissolved in about 200 parts of water, gives no precipitate with sulphate of potash. It is supposed that the formation of sulphate of lime takes place, but that the presence of the chloride of potassium, which is formed at the same time, renders it more soluble than it otherwise would be. Carbonate of lime seems to be rendered more soluble by the presence of sulphate of potash and chloride of potassium. (Ludwig Gmelin, Hand-book of Chemistry.)

On the other hand we know of the actual displacement of chlorides from solution by other chlorides, as the solubility of chloride of sodium in water diminishes, the greater the amount of chloride of magnesium therein dissolved. Sulphates also affect the relative solubility of the chlorides of sodium and magnesium. In regard to the assumption made here, that silica is driven out as carbonate of lime enters into solution, assuming the structural position of the dissolved carbonate, Bischof says, in his Chemical and Physical Geology (Cavendish Society, Vol. I, p. 199), that " although silica is separated directly from sea water by organic agency, still this separation may also take place in consequence of a displacement of the sedimentary carbonate of lime and the animal remains contained in it." He further says, "when the carbonate of lime acts as the precipitant to carbonates of magnesia, protoxide of iron and *silica*, in sea water, equivalent quantities of it enter into solution again." All of which can be interpreted as a corroboration of the view given above.

However, the exact method of interchange is described, it can hardly be doubted that the pseudomorphism by which silica assumes the form of crystallized calc-spar is closely or exactly imitated. Von Buch, in his examination of organic silicifications, concluded that the soluble silica deposited from solutions took the place *only* of the organic matter, at least at first, and that the substitution of the silica for carbonate of lime was later, and in this secondary form appeared as warts, concretionary rings, etc. Alexander Petzholdt, in his examination of a silicified belemnite, found that the silicification began on the outside, penetrating progressively through the minute tubes of its structure to the interior, finally effecting a continuous silicification from the inside to the outside. He found the same stages shown in oyster shells; and a section in the center of an oyster shell contained 51.78 per cent. silica and 47.81 per cent. carbonate of lime, with traces of iron oxide, while its exterior was entirely silicified. His observations disproved Von Buch's assumption, and established the fact that the waters carrying silica directly removed the carbonate of lime and so replaced it with opal-material (soluble hydrated quartz), and that no warts, concentric or concretionary rings were formed at all. Whether the replacement by silica of organic tissues, as the structure of wood or the horny apophyses of brachiopods, may involve less obvious conditions than those prevalent in the more ordinary mineral replacement of calcite or aragonite by silica, or not, still the formal character of the substitution is similar. Bischof, in commenting upon this similarity, says, "the penetration of the silicic acid in the minute interspaces of the fibrous carbonate of lime, as also all the appearances presented by the silicified molluscan shells, agree so completely with the penetration of the calc-spar by silicious substances, and with the entrance of the silica between the cleavage plains of the same, that doubtless we have here one and the same process of alteration. Therein, however, there is a difference between the displacement of the carbonate of lime in the molluscan shell and that in the calc-spar, in so far as the latter is frequently hollow and the former not; in the shell the space of the removed carbonate of lime is entirely, in the calc-spar only partially filled. We might ascribe this difference to the well-known inclination of silicic acid to unite itself with organic substances, if the amount of organic matter were not so small. The true explanation of this difference must await further investigations" (Chemischen and Physikalischen Geologie).

This latter contrast in the silicification of fossils and the pseudomorphism of calc-spar seems to arise principally from contrasted quantitative conditions. The solid replacement of the carbonate of lime in fossils by silica is connected with the former's slow solution, as compared with that of exposed crystallized calcite, which may be rapidly invaded by carbonated or acid waters, whereas the imbedded fossil receives the access of terrestrial waters but slowly, and also retains its carbonate of lime somewhat intermixed with organic envelopes, the sarcodic filaments that penetrate the hard parts of invertebrates, and so surrenders it to solution less quickly, with the result of acquiring a dense and complete molecular replacement. In regard to the view of the solution of carbonate of lime in water expelling its dissolved silica Bischof remarks, that in the case of the hollow crystals of calcite we are shown how the water has dissolved and removed more easily the soluble carbonate of lime than it has deposited the less easily soluble silica, an expression, which, from the point of view taken here, is simply equivalent to saying, that the amount of silica in the waters of solution was insufficient to fill the space occupied by the calcite. Subsequent crystallization of silica within these hollows would simply produce drusy surfaces on a crystalline texture of interlocked crystals. Fossils also undergo so-called secondary replacement, when their forms become distorted and rough, and little circular monticules of silica are distributed over and through their shells and skeletons. This "orbicular silica"

(Beckite markings) is customarily assigned to the later periods of the fossils change, whereas the intimate replacement of the microscopic structure took place in the earliest stage of its inhumation.

In the Trenton limestone of Wisconsin, a more or less magnesian rock, holding from one to three per cent. of soluble silica, the molluscan forms are replaced by silica, forming hard brittle pseudomorphs of much beauty ; and in the Trenton beds of Tennessee we find the corals frequently or universally silicified by secondary silicification (Columnaria, Tetradium, etc.). It would seem that the silicification of fossils, where it is of a minute and very accurate character, must have been begun before the consolidation of the limestone itself, and have been completed before the layers assumed their final lithological state. But some peculiar instances of an apparent progressive silicification continuous with the weathering of the enveloping rock, are known as where, in the Niagara limestone in western New York, fossils appear in relief above the surface of the dissolved limestone, and are seen to be complete siliceous replacements, the parts of the same fossils, or other similar fossils, enclosed within the rock a short distance below its surface, being entirely dissolved when placed in acid, evincing their calcareous nature. If this is true, the replacement must take place from the soluble siliceous constituents of the rock, which are slowly introduced into the calcareous tests and frame-work of fossils as these are dissolved in carborated waters. It would seem more likely, in most cases, as in the very siliceous and ferruginous Schoharie grit,[1] that silicification has been already partially effected, and that the action of natural solvents is to remove the associated calcareous particles and leave the siliceous residue as the representative of the fossil, somewhat less dense in texture, but a substantial and complete form. In fact, in the case of many specimens of weathered fossils, where the siliceous shells project in high relief above the limestone matrix, the surfaces of the shell are finely perforate, or small holes occur, as if the limestone had been removed from these spaces and the intervening areas of silica remained imperfectly continuous. Silicification seems to have gone on with great energy and completeness in some beds in the same formation in which other beds show but imperfect traces of its action, and this may be ascribed to a greater proportion of soluble silica, and perhaps as well to the presence of organic structures more susceptible to siliceous replacement. As regards the first course, it is true that mere excess of a quartzose matrix does not necessarily facilitate silicification, as we see in the Oriskany sandstone, which is so frequently characterized by cavities from which fossils have been dissolved by carbonated waters, though each one of those cavities is surrounded by sandstone. The extraction of this silica could not in this case be effected so as to replace the calcareous parts of the dissolved fossils, because of its insoluble nature. Soluble silica, that colloidal form which is more readily taken in solution, must be provided, for the substitution of the lime portions of fossils. As regards the second cause, it seems certain that thin and delicate tests or structures, as the septa and tabulæ of corals, the partitions and walls of bryozoans, and the fibrous texture of some brachiopodous shells are more susceptible to replacement by dissolved silica than the valves of lamellibranchs or the whorls of gasteropods.

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[1] In this formation the shells of fossil bivalves are often removed by solution, being almost entirely carbonate of lime; and the siliceous filling, colored brown by the ferruginous oxydation, remains as casts of their interiors. But in other cases silicification has partially replaced the shells, and fragments of these taken from unweathered portions of the rock show upon solution in acid siliceous scales, which remain undissolved. In the Trenton of Teneessee the weathered siliceous shell of gasteropods is continuous with the siliceous parts yet plainly seen imbedded in the unweathered limestone.

Sorby has called attention to an interesting siliceous replacement in the calcareous grit below the coralline oolite in England, where very small reniform bodies occur, converted into agate or presenting microscopic geodes, whose interior walls were lined with an agate film. Sometimes these reniform bodies are filled with calcareous spar, and these contrasted fillings are seen in the same slide side by side. Whatever these enigmatical bodies really are (Sorby was inclined to regard them as foraminiferous), they illustrate the minute way in which silicification acts, for they are on an average about $\frac{1}{200}$

of an inch in diameter, which would give nearly three million in a cubic inch. In the perforated walls of the favosite corals, where the entire skeleton of the fossil has become silicified, the minute pores are sometimes surrounded by little siliceous mammæ, which seem to have gathered under the influence of a form of concretionary concentration.

The peculiarities of preservation of the delicate internal appendages of brachiopods varies extremely, and while specimens of the same genus or species from one locality refuse to disclose their loops or spiral arms to the paleontologist, those from another, even with indifferent care and easier methods, are readily examined. Thus, the Devonian *Centronella* from England afforded imperfect preforations of the loop, etc., to the Rev. Mr. Glass, even with excessive nicety of treatment, whereas those from Michigan, by simply fracturing them in different directions, established the accuracy of Prof. Winchell's descriptions. In alluding to this Dr. Davidson says, "ordinarily by this process no certain result can be obtained, and none could be obtained in this manner from our Devonian specimens of the same genus. But in these (the American) specimens of *C. Julia* there is sufficient contrast between the color of the loop and the surrounding matrix to make the different parts of the loop very clear when revealed opaquely and by fracture. In most of the specimens the loop is of a rusty-brown color surrounded by a lighter matrix." Again, the *Athyris* of our Devonian is apt to be filled with a dark spar, which, being impervious to light, yields unsatisfactory results, whereas those of the English Carboniferous are filled "with a spar beautifully transparent and peculiarly favorable for working." This is by no means universal, as Prof. Whitfield has displayed the spires of *Athyris spiriferoides* in exquisite perfection in the Hamilton slate specimens. It is singular that, as stated by the Rev. Mr. Glass, the English fossil brachiopods never—or very rarely—exhibit a silicification of the spires in a calcareous matrix, whereas this frequently occurs in the United States, rendering the development of these delicate appendages comparatively simple, and incomparably beautiful.

Few organisms are provided with a siliceous frame-work, and except the radiolarians and the sponges animal life has limited its process of universal secretion to creating skeletons and coverings of carbonate of lime, in which there has also been mingled in many instances phosphates and occasionally corneous layers of an indeterminate mineral and organic character. Most of the fossils we are required to study originated in calcareous bodies, and were originally deposited as such, and for the most part they as fossils retain their calcareous substance to-day. A mineralogical change, however, has in many cases supervened, and the carbonate of lime, known as aragonite, which formed many shells when occupied by their living tenants, has become changed to the more stable form of the same salt, calcite. This change has been often hastened by pressure and heat, and even, perhaps, by perturbations of the earth's crust, which have reassorted the molecular units and brought them into the secondary state of equilibrium known as calcite. Sorby has shown that the calcareous portion of organisms is at first deposited in the form of granules of variable size. These "afterwards undergo more or less of crystalline coalescence. In some cases this scarcely occurs at all; but in others it does to a very considerable extent during the life of the organism, and this produces a great difference in the character of the particles into which it is resolved by decay. The falling to powder that then takes place is the result of the oxidization and removal of the organic portion, and, if no crystalline coalescence had occurred, the shell or other body might be resolved into the very minute ultimate crystalline granules; whereas, if much coalescence had taken place, it would break up into much larger ones, showing in many cases its minute structure." These observations were made with reference to the condition of the shells of Lymnæa and other fresh water molluscs in marls, but doubtless apply to the shells of marine formations, and may explain the fragmentary state of shells in limestones, while it points to an agency in preparing the calcareous mud in which they are embedded, though this latter arises more generally from partial solution of shells in carbonated water. A remarkable form of replacement occurs in calcareous fossils, as it has been shown by Zittel, Hinde and Sollas that the soluble silica of the siliceous skeletons of the flinty sponges is removed, and its place taken by carbonate of lime, or by oxide and sulphide of iron. The secondary character of this lime seems also proven by the fact that it is always crystalline, and its crystals are placed confusedly in all directions, and not in one, or, as it is technically expressed, are *unoriented.*

Prof. Nicholson, in his study of certain obscure organisms known under the general designation of Stromatoporoids, has indicated three different conditions or phases of their preservation. These organisms are in the main calcareous encrusting or turbinate masses, built up by a succession of poriferons sheets or laminæ, between which irregular spaces extend, furrowed by inosculating canals. In the first state of preservation, instanced by this author, the actual calcareous skeleton is preserved, and all cavities are infiltrated with transparent calcite, the skeleton then appearing as a brown granular or cloudy non-crystalline body. In the second method of fossilization more or less silicification has taken place, the cavities becoming solidly silicified and the skeleton remaining calcareous, or the skeleton irregularly presenting a complete siliceous frame-work. In the third method the specimens are preserved in limestones or in argillaceous deposits. The skeleton became infiltrated with fine mud or argillaceous sediment, and was dissolved out, being the less stable form of carbonate of lime—aragonite—and was replaced by calcite. Thus, the skeleton appears as clear as calcite, while the chambers, pores and canal-system of the fossil are represented by comparatively opaque calcareous mud or fine argillaceous fillings. In the skeletons and hard parts of living invertebrates the following distinctions of mineral composition have been determined :

The calcareous foraminifera are composed of calcite, with some aragonite.

The true corals are composed almost entirely of aragonite.

The alcyonarians are for the most part composed of calcite, with small amounts of aragonite and phosphate of lime.

The echinoidea are essentially formed of calcite.

The annelids are enclosed frequently in tests, tubes, or shells made of calcite.

The hard parts, exoskeletons, of crustacea contain varying intermixtures of calcite and phosphate of lime.

The bryozoans have cases composed of a mixture of calcite and aragonite.

The brachiopoda have shells composed of calcite and some phosphate of lime, the latter salt being almost limited to the shells of the inarticulate division of this class—*lingula crania discina*, etc.

In the lamellibranchs there is found some variation in the composition of shells of different genera, in some the shells are wholly aragonite, in oysters and scollops (*Ostrea, Pecten*) the shells are calcite, whereas in mussels Mytilus and Pinnas, the outer layer is calcite, the inner aragonite.

SOME MANITOBA CLADOCERA, WITH DESCRIPTION OF ONE NEW SPECIES.[1]

BY L. S. ROSS.

No record is to be found among the literature upon Entomostraca, of any systematic work done upon this interesting division of the Crustacea in Manitoba or any of the Provinces of Canada. The region is yet open to the student of the distribution of the group. A short stay in the Province of Manitoba in June, 1895 was utilized by the author in making a few collections from the region about Portage la Prairie on the Canadian Pacific Rail Road fifty-five miles west of Winnepeg. Before leaving the province some vials of alcohol were left with a resident of the town to be filled with collections. A vial was received every second week from the time of the visit until cold weather, the latest being filled Oct. 21, 1895. One vial remained to be filled the following spring.

Collections were taken by the author from the Assiniboin River, from a deep weedy slough which was once the channel of the Assiniboin River, from railroad ditches and from prairie pools and ponds. A hurried visit to Lake Manitoba gave opportunity for a few hauls of the net among the rushes along the shore.

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[1] Read before the Iowa Academy of Sciences, Dec. 1876.

An examination of the material obtained shows the presence of thirty species and varieties, one of which, and possibly two, is a new addition to the list of described species.

The forms belong to the following families:

Sididæ	1
Daphniidæ . . .	9
Bosminidæ . . .	1
Macrotrichiidæ .	4
Lynceidæ . . .	13
Polyphemidæ . .	1
Leptodoridæ . .	1
	30

The distribution of the species is given in the following table:

Assiniboin River.

Daphnia pulex DeGeer.
Ceriodaphnia consors (?) Birge.
Iliocryptus sp.?
Chydorous sphæricus O. F. Müller.
Graptoleberis testudinaria var. inermis Birge.

Rat Creek at McDonnell on Portage Plains.

Daphnia pulex DeGeer.
Ceriodaphniia consors (?) Birge.
Simocephalus vetulus O. F. Müller.
Simocephalus serrulatus Koch.
Scapholeberis angulata Herrick.
Scapholeberis mucronata O. F. Müller.
Eurycercus lamellatus O. F. Müller.
Alona costata Sars.
Graptoleberis testudinaria var. inermis Birge.
Pleuroxus procurvus Birge.
Pleuroxus excisus Fischer.
Pleuroxus sp?

Chydorus sphæricus O. F. Müller.
Acroperus leucocephalus Koch.
Polyphemus pediculus Linnæus.

PRAIRIE SLOUGH NEAR PORTAGE LA PRAIRIE.

Daphnia pulex var. pulicaria Forbes.
Ceriodaphnia consors (?) Birge.
Simocephalus vetulus O. F. Müller.
Simocephalus serrulatus Koch.
Scapholeberis mucronata O. F. Müller.
Lathonura rectirostris O. F. Müller.
Macrothrix laticornis Jurine.
Bunops scutifrons Birge.
Eurycercus lamellatus O. F. Müller.
Graptoleberis testudinaria var. inermis Birge.
Dunhevedia setiger Birge.
Pleuroxus denticulatus Birge.
Pleuroxus procurvus Birge.
Pleuroxus sp.?
Chydorus globosus Baird.
Chydorus sphæricus O. F. Müller.
Alonopsis latissima var. media Birge.
Acroperus leucocephalus Koch.
Polyphemus pediculus Linnæus.

DEEP WEEDY SLOUGH AT PORTAGE LA PRAIRIE.

Sida crystallina P. E. Müller.
Daphnia pulex DeGeer.
Ceriodaphnia consors (?) Birge.
Ceriodaphnia reticulata Jurine.
Ceriodaphnia acanthinus n. sp.
Simocephalus vetulus O. F. Müller.
Scapholeberis mucronata O. F. Müller.
Lathonura rectirostris O. F. Müller.
Bosmina longirostris O. F. Müller.
Eurycercus lamellatus O. F. Müller.
Alona quadrangularis O. F. Müller.
Pleuroxus denticulatus Birge.

Pleuroxus procurvus Birge.
Chydorus sphæricus O. F. Müller.
Camptocercus rectirostris Schœdler.
Polyphemus pediculus Linnæus.

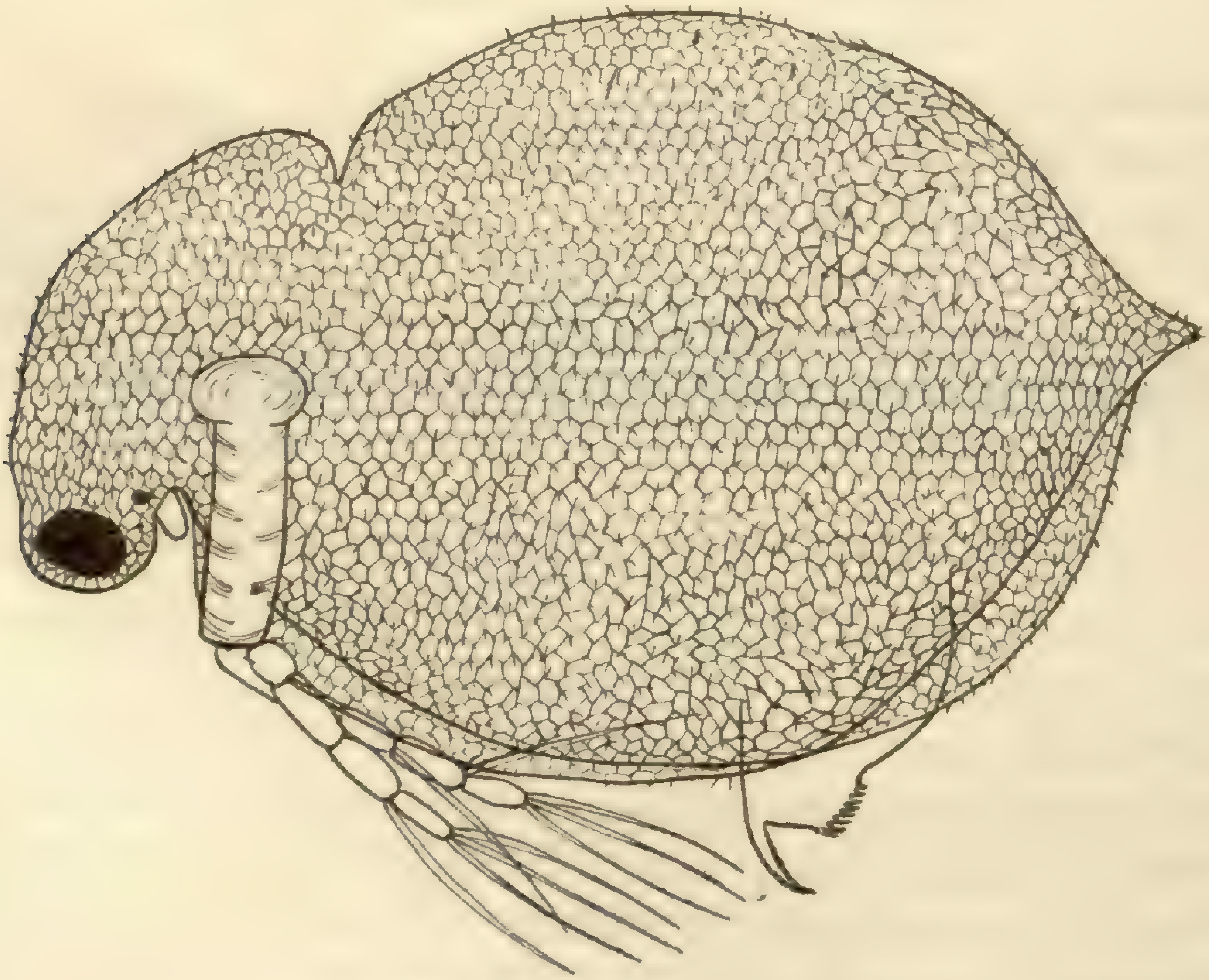
LAKE MANITOBA.

Bosmina longirostris O. F. Müller.
Chydorus sphæricus O. F. Müller.
Leptodora hyalina Lilljeborg.

DESCRIPTION OF A NEW SPECIES.

CERIODAPHNIA ACANTHINA.

The body is large, rounded, with the valves of the shell forming a well developed posterior spine. The head is separated from the body by a very deep depression. Head is low, small, rounded in front of the eye, sinuous above and angled between the eye and the antennules; the lower margin is nearly in a line with the lower margin of the valves of the shell.



Ceriodaphnia acanthina ♀

The shell is very strongly reticulated with small very sharply marked hexagonal reticulations measuring about .016 to .021 mm. across. Small sharp spines project from the angles of the reticulations, many at nearly right angles with the surface of the shell. In the possession of these spines this species closely resembles *C. setosa* Matile. No spines were seen on the rounded front of the head as are usually present in *C. lacustris* Birge. The dorsal margin of the shell is arched, curving gradually into the posterior margin.

The posterior spine of the shell may be near the dorsal margin, or one-third the distance from the dorsal to the ventral margin. When the spine is situated low the posterior shell margin above is slightly concave. The spine is as well developed as in *C. lacustris* Birge, and often ends in blunt teeth, but is not divided into two parts at the end as is sometimes the case in that species. The posterior margin of the shell curves gradually into the strongly convex ventral margin. The fornices are greatly developed extending almost the width of the shell. They are almost as broad but are not so sharply angled as in *C. lacustris* and do not end in sharp teeth.

The antennules are short and thick, reaching to or a very little beyond the angle behind the eye. Setæ are present toward the distal end. The antennæ are long and rather slender; the setæ reach nearly to the posterior margin of the shell.

The post abdomen is of moderate size slightly tapering toward the end and is armed with nine to eleven strong recurved spines of nearly equal size except the first and last which are smaller. The anal claws are, long, curved, and denticulate on the inner side with minute teeth of two sizes. The teeth of the basal two-fifths of the claw, some forty or fifty in number, are two or more times longer than those of the distal portions.

The eye is of moderate size, situated near the margin of the head or back a short distance from the margin. The lenses do not project far from the eye pigment. The pigment fleck is small, rounded, and situated back of the lower portion of the eye at a distance approximating half the diameter of the eye.

In general shape the species resembles *C. rotunda* Straus. The posterior spine is not as near the dorsal margin as Kurtz figures it in *C. rotunda*, but is in nearly the same position as in a specimen examined of that species identified by G. O. Sars of Norway. The reticulations are as distinct and the double contoured markings (due merely to depth of reticulated areas) mentioned by Herrick and used in his key, are fully as prominent as in *C. rotunda.*

The reticulations and the minute spines on the surface of the shell are very like those described and figured by Matile in *C. setosa.* The measurements of *C. setosa* are but little over half those of *C. acanthinus.* Matile's description of *C. setosa* gives the length .42 to .54 mm. and the height .27 to .36 mm. while *C. acanthinus* measures from .80 to 1 mm. in length, and .70 to .77 mm. in height. The head of *C. acanthinus* is larger and extends nearer to a level with the ventral margin of the shell. Some specimens of *C. reticulata* taken from the same slough at the same time have the reticulations nearly as distinct as in *C. acanthinus* and also possess minute spines upon the surface of the shell. The two species are distinct, however, because of differences in the shape of the body, and of the difference in the armature of the anal claws.

The males were not seen. The mature females measure from .80 to 1. mm. long and .70–.77 mm. high. Found in abundance in a weedy slough in late May, 1896 at Portage la Prairie.

Notes on Some of the Species.

Sida crystallina : Was taken only from a deep weedy slough at Portage la Prairie.

Ceriodaphnia reticulata : Was in a bottle sent in May, 1896 from the slough at Portage la Prairie. The specimens have the reticulations very sharply marked. Some show numerous short spines at the angles of the reticulations. The number of spines on the anal claw varies somewhat. This species was found with *C. acanthinus.* It differs from the typical *C. reticulata* in the distinctness of the reticulations and in the presence of spines on the shell in some individuals.

Ceriodaphnia consors : Numerous specimens were found at various places which are with much hesitation referred to this species.

Scapholeberis angulata: Was taken only in small numbers, a few being found in Rat Creek on Portage Plains.

Daphnia pulex var. *pulicaria:* Was found in small numbers in a prairie slough near Portage la Prairie.

Simocephalus daphnoides (?) The body is robust, with greatest height a little behind the middle. The head is rounded in front and has no spines. Lower margin of the head is slightly concave, straight, or even slightly convex to the base of the short beak which may project at nearly a right angle to the lower margin of the head. The head is separated from the body by only a very slight depression. Depth of the head in one specimen is .077 mm.; length from the posterior margin of the base of the antennæ .052 mm. The head has a daphnia-like appearance. The ventral margin of the shell has few very short blunt teeth. The posterior margin from short blunt posterior spine toward dorsal margin has teeth better developed than those on the ventral margin. The dorsal margin teeth continue forward a short distance. The posterior spine is very short, blunt, armed with short teeth and is situated little above the middle of the posterior margin.

The eye is of moderate size, situated near the front of the head or at a short distance from the front, and at a distance from the lower margin equalling one-half the diameter of eye, or at a distance slightly greater than diameter. Pigment fleck is irregular in shape; elongated, rhomboidal and oval forms were seen. Pigment fleck is small, situated near the posterior margin of the head.

Specimens measured vary in length from 2.04 mm. to 2.53 mm.: in depth from 1.20 mm. to 2.04 mm.

The description of *S. daphnoides* as given by Herrick in AMERICAN NATURALIST, May, 1883, and in Entomostraca of Minnesota, is rather brief. Herrick states that the form is found only south of the Tennessee River; but a comparison of specimens taken in Manitoba with the original drawings and brief description in the AMERICAN NATURALIST makes it appear that the form is found even in that northern province.

Lilljeborg's "Crustaceis" published in 1853 gives drawings of *S. vetulus* with the lower margin of the head as nearly straight as in the figures by Herrick of *S. daphnoides*, and the general outline of the body almost as daphnia-like in appearance.

Eylmann in the "Berichte der Naturforschenden Gesellschaft zu Freiburg" Zweiter Band, Drittes Heft, published in 1886, figures the lower margin of the head of *S. vetulus* straight to the short beak, and the body with greatest height at the middle. A specimen of *S. vetulus* identified by G. O. Sars, of Norway, and examined by the author has the lower margin of the head straight to the very short beak and the eye situated at a distance from the lower margin equal to about one-half the diameter of the eye.

Herrick says in his description that the curved spines present in the other species at the caudo-ventral angle of the shell are absent from *S. daphnoides*. If this be constant it seems to be the only character not possessed by specimens of *S. vetulus*.

The specimens taken in Manitoba, and also in Iowa, vary in size, and shape of the head and of the body; there are such grades of variation, and authors figure such differences of form in *S. vetulus;* that it seems very probable that *S. daphnoides* is merely an extreme form of *S. vetulus*.

Bosmia longirostris: Found in only two collections; one from Lake Manitoba and the other from a slough at Portage la Prairie.

Macrothrix laticornis: This species was met with only in a shallow prairie slough and was by no means abundant.

Bunops scutifrons: This beautiful species was found rather frequent in the shallow prairie slough at Portage la Prairie.

Iliocryptus sp.?: A few shells and one individual of this genus were taken from the Assiniboin River. The species is probably longiremus Sars.

Alona quadrangularis: Alona costata: There is some question as to the identification of these two species. Only a single individual of each was found. The specimen that may be *Alona costata* is not strongly striated but other characteristics agree with descriptions of this species.

Graplolcberis testudinaria var. *inermis*: Although taken at three different places this species was rare. A few individuals were found in Rat Creek, one in the collection from the Assiniboin River, and one individual and a few shells from a prairie slough.

Dunhevedia setiger: This species is apparently rare during the season of the year the collections were taken, as only a few specimens were found. They were taken from a prairie slough. Birge, in his "List of Crustacea Cladocera from Madison, Wisconsin," mentions the fact of *D. setiger* being one of the rarest of Cladocera in that region, but that in the month of August he found them in immense numbers, both males and females.

Pleuroxus sp?: The shell is long and low, in some specimens evenly arched from the posterior dorsal angle to a point a little in front of the brood chamber from which the curve is flattened slightly to a distance including the basal third of the long sharp rostrum. In others the dorsal margin is evenly arched from the postero-dorsal angle to the rostrum. The head is small, high, with the long sharp curved rostrum far from the anterior margin of the shell, parallel with it and reaching nearly to a line with the ventral margin of the shell. The ventral margin is straight for two-thirds of its length from the anterior margin; the remaining third curves gently upward and has a single small tooth pointing backward, a little in front of the sharp curve into the posterior margin. The ventral margin has long pectinated setæ becoming shorter toward the posterior end of the shell. The anterior margin has setæ for a short distance from the ventral margin. A blunt posteriorly directed projection is formed by the postero-dorsal angle of the shell.

The post abdomen is long, slender, truncate, tapering toward the end. The posterior edge is slightly concave and is armed with about 18 to 20 or more small spines. The spines at the distal end of the series are much the longer and stronger. Anal claws are pectinated, long, and slightly curved. The second basal spine is longer than the first.

The eye is of moderate size. Pigment fleck is about one-half as large as the eye and is situated one-fourth the distance from the eye to the end of the rostrum. The antennules are cylindrical with setæ at the end and a lateral seta. Length of antennule about equals the distance between the eye and the pigment fleck. Antennæ are short, small, with long setæ.

The specimens do not agree in all respects with the descrigtion given by Birge of *Pleuroxus gracilis* var. *unidens*, but do agree in many points. The largest specimen found measures .60 mm. in length by .38 mm. in height; another measures .60 mm. long and .33 mm. high. Birge gives a measurement of .85 mm. by .46 mm. and states that the species is the largest yet seen. The original description of *P. gracilis* var. *unidens* states that, "the striation is very plainly marked. The specimens found by the author are only very faintly striated and that most distinctly at the anterior part of the shell where the lines of striation are approximately parallel to the anterior margin. The larger part of the surface is free from markings, either striation or reticulation as far as could be observed. The shell is more arched dorsally than *P. gracilis* is figured by Matile. Birge's description of *P. gracilis* var. *unidens* says: "The upper posterior angle is prolonged into a projection, quite characteristic, seen, I believe, in no other species."

In the specimens found there is a slight projection, at the angle but not so pronounced as figured by Birge and by Herrick. The lower posterior corner is rounded and has a small tooth anterior to it as in *P. gracilis* var. *unidens*.

It seems improbable that the differences between the specimens, and the description and drawings of *P. gracilis* var. *unidens* should fall within the range of variation of a variety. The males were not seen. Collected in small numbers in June, 1895 from a shallow slough and a small creek.

Pleuroxus excisus: Only one or two individuals were observed. These were taken from Rat Creek, a sluggish stream flowing into Lake Manitoba.

Alonopsis latissima var. *media:* The specimens resemble the species described by Birge but have some points of difference.

Birge's description is as follows: "Rostrum prolonged, and shell sharp, somewhat quadrangular in shape, marked by striæ. The dorsal margin is convex, the hinder margin nearly straight. Its lower angle is rounded and is without teeth. The lower margin is concave and has long plumose setæ. The front margin is strongly convex. The postabdomen is long and slender, resembling that of Camptocercus, and is notched at the distal extremity; it has two rows of fine teeth and some fine scales above them. The terminal claws are long, slender, with a basal spine in the middle, and are serrated. The antennules are long and slender, but do not reach to the end of the rostrum. They have each a flagellum and sense hairs. The antennæ are small and have eight $\left(\frac{300}{311}\right)$ setæ and two $\left(\frac{100}{100}\right)$ spines. The labrum resembles that of *A. leucocephalus*, but is slightly prolonged at the apex. The intestine, cæcum, and color resemble those of Acroperus. There is a trace of a keel present on the back."

Herrick's statement, in part, is as follows: "The specimens seen in Minnesota resemble this species, (*A. latissima* var. *media*) very nearly, apparently, but there are some differences. The terminal claw has an increasing series of spines to the middle; there seems to be no lateral row of scales beside the anal teeth; the abdomen is rather broad at the base and narrows toward the end. The shell is not square behind. The lower margin has a few long hairs anteriorly which are followed by a series of teeth, and in the concave part a somewhat longer set to a point just before the lower curved angle."

In most respects the Manitoba specimens agree more nearly with Herrick's description than with Birge's. A few points of difference are noted. In the Manitoba specimens a few long hairs are present on the lower margin anteriorly, then at a little distance posteriorly from the hairs are short sharp bristles, hardly heavy enough to be called teeth, becoming largest on the concave part of the margin. In one specimen the end of the abdomen is deeply cleft, the posterior lobe bearing four very strong teeth of nearly equal size.

Herrick says that hexagonal reticulations are seen upon the shell of the embryo yet in the brood sac. In several sexually mature females observed faint reticulations are present, more distinctly seen near the ventral margin.

Polyphemus pediculus: This species was found to be quite common in the Portage Plains region. It has not been reported from Iowa, and Birge says it is not common in southern Wisconsin. Although reported from Georgia it seems to be more commonly found in the north.

THE FLORIDA SEA-MONSTER.

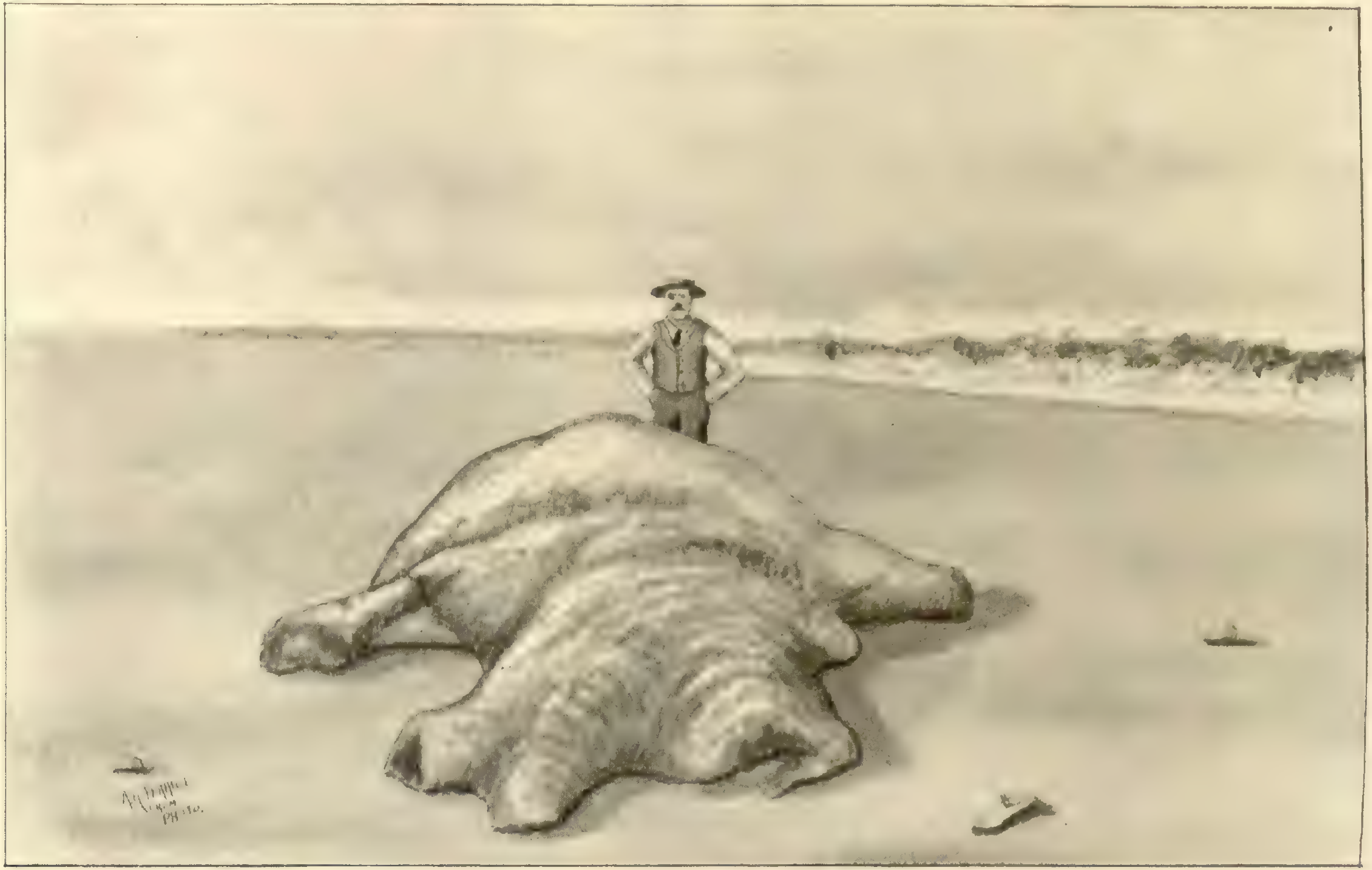
BY A. E. VERRILL.

On the 5th of December, 1896, a portion of a very large marine animal was cast ashore on the beach twelve miles south of St. Augustine, Florida. When it first came ashore it was much mutilated at one end, and had evidently been dead some time, and was, apparently, in an advanced state of decomposition. Contrary to expectation, it has resisted further decay, and still remains, after more than three months, nearly in the same state as at first. It was first brought to my notice by Dr. De Witt Webb, who has devoted a great amount of time and labor to its investigation and preservation. Through him I have received a dozen different photographic views of it, taken at different times, and showing it both in its original state and when it had been moved and partly turned over. Quite recently he has sent me several large masses of the thick and firm integument, of which the mass is mainly composed. By his efforts it has recently (with much labor) been moved several miles nearer to St. Augustine, to the terminus of a railroad, and protected from the drifting sand. It is likely to keep some months longer without much change, and to be visited by large numbers of people. The figures now given are copied from photographs made two days after it came ashore. At that time the sand had collected around it to the depth of about eighteen inches.

Its length is 21 feet; breadth about 7 feet; height about 4½ feet, when the sand was removed. It weight was estimated at about 7 tons.

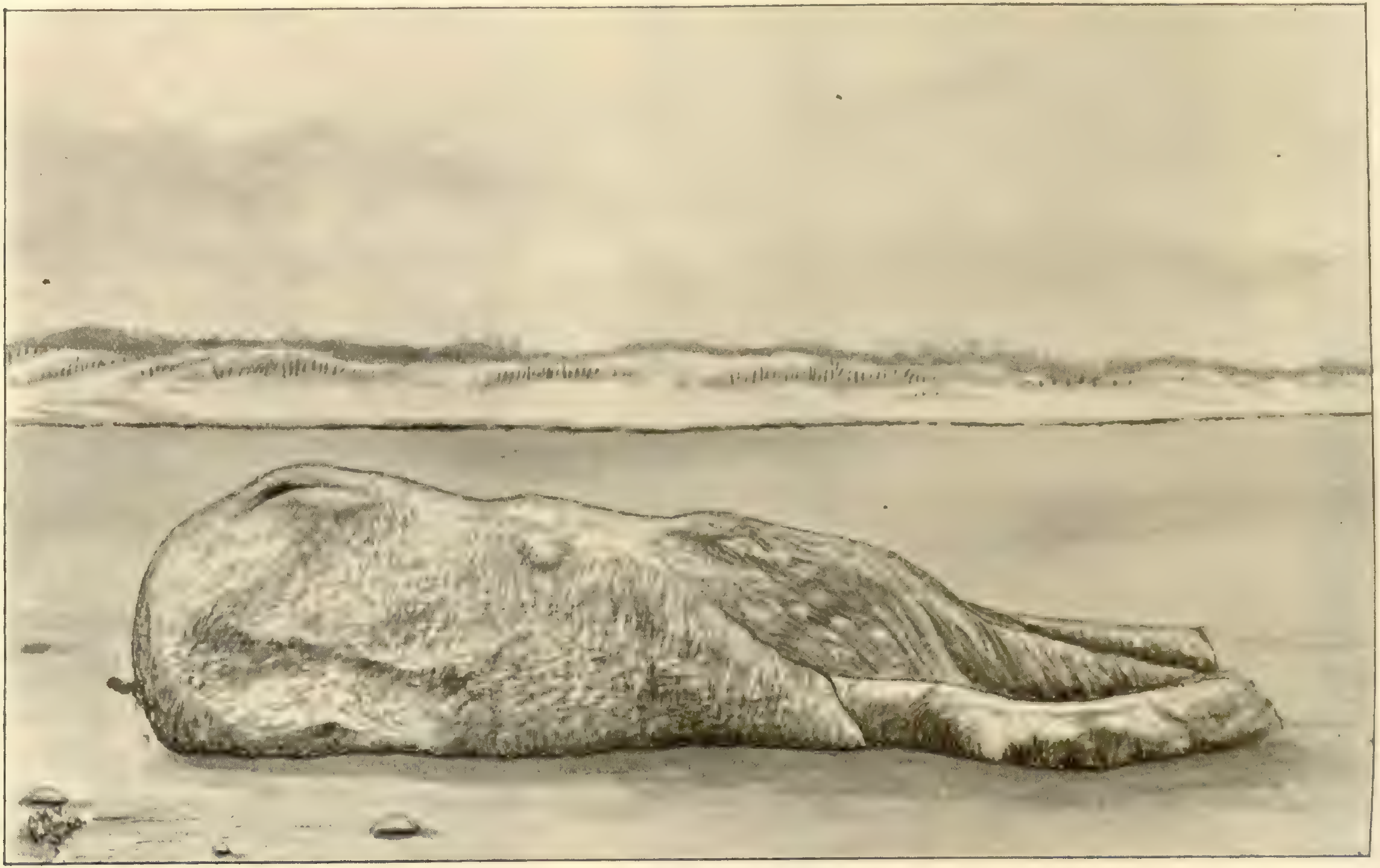
As shown by the figures, it has an elongated, pear-shaped form, broadly rounded at the larger, closed end, and considerably flattened toward the smaller and much mutilated end. At this end, as shown in both views, there are large, divergent ridges covered by the frayed-out fibrous tissues. These ridges are folds of the integument, but were at first mistaken for the stumps of arms, like those of an *Octopus*, and were so described

PLATE VII.



The Florida Monster, end view, from a photograph.

PLATE VIII.



The Florida monster, side view, from a photograph.

in letters received by me. Moreover, Mr. Wilson who visited it, when first found, claimed to have found a portion of an attached arm, 36 feet long, buried in the sand. This last statement, in the light of later investigations, must have been erroneous and was entirely misleading.[1] At that time, however, it seemed quite consistent with the form and appearance of the mass, which was described by Dr. Webb as closely similar to the body of the common small octopus. The photographs show this resemblance very clearly ; and the ridges at the mutilated end, then supposed to be the stumps of mutilated arms, seemed to confirm the view that the mass was the mutilated body of a huge octopus,[2] and as such it was described by me in the *American Journal of Science* and elsewhere.

As soon as specimens of the tissues were sent to me, even a hasty examination was sufficient to show that this view was not correct, for instead of being composed of hardened muscular fibers,[3] as had been supposed, the thick masses of tissue were found to consist almost wholly of a hard, elastic complex of connective tissue fibers of large size. The masses sent vary from four to ten inches in thickness. They are white, and so tough that it is hard to cut them, even with a razor, and yet they are somewhat flexible and elastic. The fibers are much interlaced in all directions, and are of all sizes up to the size of coarse twine and small cords. The larger fibers unite to form bundles extending from the inner surface radially. According to Dr. Webb, who opened the mass, these cords were attached

[1] The memoradum written by Mr. Wilson and forwarded to me by Dr. Webb is as follows: "One arm lying west of body, 23 feet long; one stump of arm about 4 feet long; three arms lying south of body and from appearance attached to same (although I did not dig quite to body, as it laid well down in the sand and I was very tired), longest one measured over 23 feet, the other arms were three to five feet shorter."

[2] This was also the opinion of a large number of naturalists who saw the photographs sent to me.

[3] A highly contractile muscular integument is an essential feature of all cephalopods.

Statements that the creature cannot be an Octopus, but is of cetacean nature, were published by me in several local daily papers within a day or two after the specimens were first examined by me, and shortly afterwards in the *New York Herald* and in *Science*.

in large numbers to a central saccular organ, which occupied a large part of the interior of the thicker part of the specimen. This might, perhaps, represent the spermaceti case. Naturally most of the interior parts had decomposed long before it was opened,[4] so that we lack details of the interior structure. Externally there is but little trace of cuticle. The surface is close-grained and somewhat rough, with occasional gray patches of what may be remnants of the outer skin, much altered by decay. The thick masses contain a slight amount of oil, and smell like rancid whale oil, but they sink quickly in water, owing to their great density. No muscular tissue was present in any of the masses sent, nor were there any spaces from which such tissues might have disappeared by decay.

It is evident that such a dense and thick covering of fibrous connective tissue could not have come from any mobile part of any animal, but must have served for passive resistance to great pressure or concussion.

The structure of this integument is more like that of the upper part of the head of a sperm whale than any other known to me, and as the obvious use is the same, it is most probable that the whole mass represents the upper part of the head of such a whale, detached from the skull and jaw. It is evident, however, from the figures, that the shape is decidedly unlike that of the head of an ordinary sperm whale,[5] for the latter is oblong, truncated and rather narrow in front, "like the prow of a vessel," with an angle at the upper front end, near which the single blow-hole is situated. No blow-hole has been discovered in the mass cast ashore. There is a depression, shown in the side-view, near the large end, that I at one time thought might be a blow-hole; but Dr. Webb states, that it is a "sulcus" or pit about two feet long and six inches deep, apparently not connected with the interior cavity and probably due to mutilation. The specimen was doubtless floated ashore by the gases of decomposition accumulated in the interior cavity, indicating the absence of any free external opening to it, from which the gases could escape.

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[4] It should be stated that after visiting the specimen, two days after it came ashore, Dr. Webb did not again see it for several weeks, owing to very stormy weather and its distance from St. Augustine. Nor did anyone suppose, at that time, that its tissues could be preserved or utilized for study, owing to its apparently advanced decomposition. The outer skin rapidly decayed, but the fibrous mass seems very durable.

[5] The dimensions of the head of a large sperm whale, 84 feet long, are given as follows: Length, about 25 feet; depth, 8 to 9 feet; breadth, 5 to 6 feet. The blow-hole is like a slit, about a foot long, and has a sigmoid curve. It is on the left side, close to the tip of the nose. The spermaceti case occupies a large space within the right side of the head. It is supported by strong fibrous tendons.

Photographs made of the under side of the thicker part, when it was turned up by powerful tackle, show an irregular roughness on that side, extending well forward, but not to the end. This roughness may be due to abrasion, or it may show where the skull was attached. If the mass really came from the head of a sperm whale, it would seem that it must have projected farther forward beyond the upper jaw than does the nose of an ordinary sperm whale, and it would, apparently, have been much broader and blunter, or "bottle-nosed." It is possible, of course, that its form has changed considerably since death; but in view of its wonderful toughness and firmness, no great change of the larger end, supposed to be the anterior or nose-end, is probable. All the pulling and hauling and turning of it partly over, by the aid of six horses and strong tackle, have not served to change its shape materially, or rather its elasticity serves to restore it to its former shape. Its toughness and elasticity remind one of the properties of thick vulcanized rubber.

It is possible to imagine a sperm whale with an abnormally enlarged nose, due to disease or extreme old age, which, if detached, might resemble this mass externally at least. It seems hardly probable that another allied whale, with a big nose, remains to be discovered. Notwithstanding these difficulties, my present opinion, that it came from the head of a creature like a sperm whale in structure, is the only one that seems plausible from the facts now ascertained.

EDITOR'S TABLE.

Whatever fair differences of opinion may exist as to the general protective policy of our government, there can be among intelligent people no two opinions as to the provisions in the new Dingley tariff bill, taxing books, apparatus and antiquities imported into the country. A more extraordinary anachronism than these provisions, can scarcely be conceived. With few exceptions since 1789, books, philosophical apparatus, etc., imported for the use of colleges, libraries, and other incorporated institutions, have been admitted free of duty; and within a few years, through representations of various scientific bodies, scientific books in other than the English language imported for the use of private students were also placed on the free list. It was insisted that if institutions should have their books free, private students were still more intitled to such consideration.

The proposed legislation reverses all this, and puts us in the position as to enlightenment, which we occupied prior to 1789, and below that of any existing nation civilized or uncivilized. It shows that the supposed interest in public education professed by such legislators is a sham, and that they are willing to see their fellow countrymen fall below the generally too prevalent level of mediocrity to something still less noble. Probably they do not conceive of the possibility of such a degeneracy, but the opinion held by a people that they are the greatest and wisest on earth, is generally inversely as the truth of the assumption. The more ignorant a man or a nation, the surer it or he is of its or his superiority. We cannot afford in this country to shut ourselves out from the sources of culture as developed in other countries. The supposition that we benefit even in a financial way by such exclusion is fallacious. Is it necessary to say in this country to men sent to legislate for us, that a piece of scientific or artistic work, or an object of antiquity, having been once produced, cannot be produced again? It is necessary to say to men of sense, that the industries fostered by science and art, as those of the printer, engraver, etc. are developed and not suppressed by the abundant introduction of the works of other countries? In the scientific field the work done here is greatly stimulated by the knowledge of the work done abroad, and our ability to do our own work is largely dependent on it.

In fact all the materials of study and research whether imported by institutions or by individuals should be placed on the free list, and that whether they be printed in the English language or not, if we are to maintain a place among civilized nations. It is true that we have legislators who object to laws providing bodies for the study of anatomy in our medical schools; and perhaps such as these desire to see the education of our citizens taxed and suppressed in other ways; but it is scarcely possible that a sufficient number of members of our national legislature can be found to support the provisions of the Dingley bill, which will restrict the development of intelligence in this country to the rich, and cut it off from the poor.

Since the above was written protests from many institutions of learning have reached Washington, and it is said have produced some impression. We hope that this may be true, and that education may be fostered by the Dingley bill as well as it has been done under the Wilson bill.

THE present regulations of the Universal Postal Union admit specimens of Natural History to the mails thereof only at letter rates, five cents per half ounce or fraction thereof.

At the International Congress of Zoology, held at Leyden, Holland, in September, 1895, Dr. Chas. Wardell Stiles, official delegate of the U. S. Government, offered resolutions, which were subsequently adopted, that the Swiss Goverument be requested, through its delegate to the Congress of Zoology, to propose to the next International Postal Congress an amendment to the regulations thereof whereby specimens of Natural History shall be carried in the mails of the Universal Postal Union at the rates for samples of merchandise; that an appeal should be addressed to all the delegates and members of the Congress of Zoology to bring this amendment to the notice of their respective governments, so that those governments should instruct their delegates to the Postal Congress to act favorably upon the same; that copies of these resolutions be sent by the Secretary of the Congress of Zoology to all governments forming part of the Universal Postal Union and which were not represented at the Congress of Zoology.

In accordance with these resolutions, Dr. Stiles suggested to the committee of the Academy of Natural Sciences of Philadelphia in charge of the matter of postage on Natural History specimens, that, although it is probable that the U. S. Government will vote in favor of this proposed amendment, seeing that it is the same proposition which the United States had presented at the last International Postal Congress of Vienna, the cause would be helped by the Academy adopting resolutions in favor of this proposed amendment and requesting the

Postmaster-General at Washington to instruct our American delegates to vote in favor of it.

This the Academy has done, but other American scientific bodies should join in the work, adopt similar resolutions and send them to our Postmaster-General that he may know that the students of natural history in the United States eagerly desire such a reduction in postage rates. The next International Postal Congress meets at Washington on the fifth of May next. We hope that all those who are aquainted with the facts will use such means and influence as may be at their command to help in the accomplishment of this end.

For the guidance of those who will aid in the manner suggested, a translation of the original French text of the amendment referred to is as follows:

"Amendment to Article XIX (samples) 4, of the Regulations of Details and Order.

> "5. Objects of natural history, dried or preserved animals and plants, geological specimens, etc., of which the transmission has no commercial interest, and the packing of which conforms to the general conditions concerning packages of samples of merchandise."

If this amendment be adopted by the Postal Congress, specimens of Natural History can be sent to countries of the Universal Postal Union at the rate of one cent for every four ounces.

The directorship of the U. S. National Museum has been acceptably filled by the appointment of Dr. C. D. Walcott director of the U. S. Geologic Survey, but the appointment is said to be a temporary one. Mr. Richard Rathbun has been appointed Assistant Secretary of the Smithsonian Institution. Mr. Rathbun has especial qualifications for the directorship of the U. S. Fish Commission and it is to be hoped that President McKinley will make him his appointee.

RECENT LITERATURE.

Sudworth's Nomenclature of the Arborescent Flora of the United States.[1]—If it were necessary to prove the increase in the scientific nature of the work done in the United States Department of Agriculture one would have to do no more than compare the book before us with the publications from the same division a few years ago. It is a source of much gratification to American botanists that the botanical publications made by the general government are of the highest character, ranking equal to if not above similar publications from any other country.

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[1] Nomenclature of the Arborescent Flora of the United States, by George B. Sudworth, Dendrologist of the Division of Forestry. Prepared under the direction of B. E. Fernow, Chief of the Division of Forestry. [Bulletin No. 14, U. S. Department of Agriculture, Division of Forestry]. Washington, Government Printing Office, 1897. Issued January 21, 1897, 8vo, pp. VIII+319.

Mr. Fernow himself writes the introduction, in which he makes some very pertinent remarks concerning the matter of botanical nomenclature, indicating very clearly the position which he occupies in the nomenclature controversy. He states the matter very concisely as follows: "The essential basis upon which the revision has been made is the so-called 'law of priority,' i. e., for species and varieties the specific or varietal name has been taken up which was first used by the author who first described the plant, and for genera the first established generic name either alone or in combination with a type specific name. In order to avoid obscurity and uncertainty, the publication in which for the first time the binominal nomenclature was used persistently, namely, Linnaeus's Species Plantarum (first edition, 1753) has been made the starting point, in accordance with an expression of the botanists of the Botanical Club of the American Association for the Advancement of Science. Objections have been made to the injustice committed in ignoring earlier names; the objectors overlook that it is not a matter of justice primarily, but of expediency, which leads to the adoption of the law of priority, and it would be inexpedient to go back to an earlier date than the one which firmly establishes our present system of notation."

An examination of Mr. Sudworth's work shows that he has done it with much thoroughness. The citations are very full, and the excellent plan is followed throughout of appending to each citation its date. After a full citation of synonyms the various common names used in different parts of the country are given. This at once shows that what every botanist has believed is true as to the unreliability of such names. Thus we find that the Balsam Fir (*Abies balsamea*) bears the following names: Balsam Fir, Balsam, Canada Balsam, Balm of Gilead, Balm of Gilead Fir, Blister Pine, Fir Pine, Fir Tree, Single Spruce, Silon Pine, and Sapin. The Plane Tree (*Platanus occidentalis*) is known as Sycamore, Buttonwood, Buttonball Tree, Buttonball, Plane Tree and Water Beech.

The following examples will show how the species are treated, and will convince everyone of the great usefulness of the work.

Catalpa catalpa (Linn.) Karsten. *Common Catalpa.*

SYN.—*Bignonia catalpa* Linnæus, Sp. Pl., Ed. 1, II, 622 (1753).
Catalpa bignonioides Walter, Fl. Caroliniana, 64 (1788).
Catalpa cordifolia Moench. Meth., 464, (1794).
Catalpa ternifolia Cavenelles, Desc. Pl., 26, (1802).
Catalpa syringaefolia Sims, in Bot. Mag., XXVII, t. 1094, (1808).
Catalpa communis Du Mont de Courset, Bot. Cult., Ed. 2, III, 242, (1811).
Catalpa catalpa Karsten, Deutsch. Fl., 927 (1882).

COMMON NAMES.

Catalpa (Mass., R. I., Conn., N. Y., N. J., Pa., Del., W. Va., N. C., S. C., Ala., Ga., Fla., Miss., La., Ark., Ky., Mo., Ill., Kans., Nebr., Iowa, Mich., Wis., Ohio, Minn.).
Indian Bean (Mass., R. I., N. Y., N. J., Pa., N. C., Ill.).
Beantree (N. J., Del., Pa., Va., La., Nebr.).
Catawba (W. Va., Ala., Fla., Kans.).
Cigartree (R. I., N. J., Pa., W. Va., Mo., Ill., Wis., Iowa).
Catawba-tree (Del.).
Indian Cigartree (Pa).
Smoking Bean (R. I.).

It remains for me to commend the typography and the uniform decapitalization of specific names. It is a thoroughly good, modern piece of work.—CHARLES E. BESSEY.

Atlas und Grundriss der Bakteriologie und Lehrbuch der speciellen bakteriologischen Diagnostik. Von Prof. Dr. K. B. Lehmann und Dr. R. Neumann. Teil I, Atlas. Teil II, Text. Verlag von J. F. Lehmann, München, 1896.

This is a general work on bacteriology covering much the same ground as Flügge's *Die Mikroorganismen*, but in a very different manner. About 60 of the more common animal pathogenic and saprophytic forms have been studied more or less carefully and re-described according to a pre-established scheme, so that their behavior on all the common media may be readily compared. Many other species are briefly mentioned. These 60 species are figured in the Atlas, and Dr. Neumann, the artist, has been peculiarly happy in some of his representations, if not in all. Streak and stab cultures are given in their natural tints, usually on a black background, the agar or gelatin being represented as absent or black. The Atlas contains 63 colored plates, including more than 600 separate figures, most of which are original.

On table 28 there are two figs. X, one of which is undescribed. On tables 12, 19, 20, 55, etc., some of the figures have been accidentally transposed. Rights and lefts have also been transposed by the lithographer in some cases, as on table 37 II. There are occasional misprints as "stichcultur" for "strichcultur" in tables 41, 43, 44, 56, etc. More important is the fact that several scales of magnification are used in representation of the individual bacteria instead of the generally agreed upon magnification of ×1,000. The Atlas is very attractive and cannot fail to be of much use. What of the text? This consists of 448 12 mo. pages on good paper, in clear Roman type easy to read, very systematically arranged, and with a good index at the end. The greater part of the book is devoted to the detailed description of the 60 species, and much of this part the reviewer has only dipped into here and there. How generally well this part has been done, or how many are the sins of omission and commission can be told only after the book has been used, or by those specially familiar with given organisms. It seems to be a good piece of work. Usually, each organism is described with reference to the following particulars: scientific name, common name, synonyms, literature, microscopic appearance, spores, motility, affinity for stains, need of oxygen, rapidity of growth, gelatine plates (*a*. natural size, *b*. magnified 50 times, 70 times, etc.,), gelatin stab, agar plates (*a*. natural size, *b*. magnified 50 times, etc.,) agar stab, agar streak, boullion, milk, potato, conditions of spore formation, vitality, chemical activities, occurrence, nerve pathogeneis, nearly related species. This descriptive part of the book is preceded by a general discussion of the subject of bacteriology, which certainly deserves praise. In a space of 95 pages Dr. Lehmann has brought together the principal facts respecting the morphology and biology of this group of organisms. His statements are clear, exact, and in the main happy, whether or not one agrees with all of his propositions. One need not expect to find entire up-to dateness in any book. No book can take the place of the current journals, least of all in a rapidly growing science, but this one is so very good that it deserves to find its way speedily into every laboratory. All the way through, in what is omitted as well as in what is brought forward prominently, there is not only evidence of a wide acquaintance with literature and of mature judgment, but also proof that the authors have become familiar with all the details of their subject by long experience in the laboratory. Following the descriptive portion of the book is a useful "Anhang" giving the briefest direction for the microscopic examination of bacteria, staining, preparation of culture media, etc. This will prove helpful to beginners. Finally at the end of the book is a folded sheet giving in tabular form, so that it may be seen at a glance, some of the principal peculiarities of these 60 organisms, i. e., size, flagella, whether staining by Gram's method, aerobic or anaerobic, liquefaction of gelatin, growth in bouillon, growth in milk, spore formation, pigment on agar, formation of H_2S, indol reaction, amount of acid produced from grape sugar, gas production, growth in CO_2 and finally amount of growth in various media titrated as follows: (1) Neutral to phenolphthalein; (2) No. 1+10 cc. per litre of $\frac{N}{1}$ Na OH; (3) No. 1+10 cc. per litre of $\frac{N}{1}$ H_2SO_4; (4) No. 1+20 cc. per litre of $\frac{N}{1}$ H_2SO_4. Authors have used phenolphthalein for titrating media regularly since 1894 and recommend it for general use. "Jedenfalls kann der mittelst Phenolphthalein neutral hergestellte Nährboden unbedingt als Universalnährboden empfohlen werden." All the bacteria figured in the Atlas were grown on media slightly alkaline to phenolphthalein, and most of the 60 sorts bore the extra 10 cc. of alkali and the 10 and 20 cc. of acid. This seems rather surprising to the writer and certainly cannot be assumed to hold good for all species. My experience would lead me to select for a universal medium a grade of alkalinity considerably less than the zero or neutral point of phenolphthalein, i. e., one nearer the zero of the best neutral litmus paper, as I am satisfied that some species will not grow on media as alkaline as here recommended. In conclusion this book may also be commended to the physician and general reader who wishes to know something about bacteria without becoming swamped in details. Its remarkably low price (15 marks) puts it within the reach of everybody.—ERWIN F. SMITH.

Science Sketches.[2]—This small book of twelve reprints needs little comment. Those who read the sketches in *Popular Science Monthly* and elsewhere will doubtless desire to have them collected into one volume. It may be noted that the papers "Agassiz at Penekese," "The Fate of Iciodorum," "The Story of a Strange Land" and "How the Trout came to California" have taken the place of certain others in the first edition.—F. C. K.

Recent Papers Relating to Vertebrate Paleontology.[3]—The first paper below cited is a review by Dr. Baur, of Chicago, of a paper by Van Bemmelen on the Phylogeny of Tortoises read before the Zoological Congress of Leyden. In this review Baur shows that Van Bemmelen has fallen into a good many errors of interpretation based on embryologic grounds, and presents a sketch of what is no doubt the correct phylogeny of the order Testudinata. The two papers constitute an excellent commentary on the necessity of interpreting embryologic data by the facts of paleontology. An appendix discusses briefly the characters of the Otocœlid family of the Cotylosauria, which the reviewer has regarded as the Permian ancestor of the tortoises (Proc. Amer. Philos. Soc., 1896, p. 122). Baur does not consider this proposition to be proven. He observes that the element which I have called clavicle includes both clavicle and cleithrum, but produces no evidence to support such a view. Were Otocœlus a Stegocephal, his idea might be probable, although the cleithrum is not distinctly visible in the Stegocephal Eryops; but as the former genus is a Cotylosaurian, i. e., a reptile, it is highly improbable, as no reptile is known to possess this element. He also remarks that the possession of a carapace means "gar nichts" in this connection. When, however, we read (p. 557) that "the characteristic of the tortoises is the carapace" it is evident that the words "gar nichts" are much too emphatic. Indeed the possession of a carapace is the essential of an ancestor of the Testudinata, since the Triassic forms possess one already well developed, as Baur has the merit of showing.

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[2] David Star Jordan, 2d Ed. A. C. McClurg & Co., Chicago, $1.50.

[3] Bemerkungen über die Phylogenie der Schildkröten, von G. Baur, Anatom. Anzeiger, XII, 24-25, 1896, p. 561. Jena.

On the Morphology of the Skull of the Pelycosauria and the Origin of the Mammals, by G. Baur and E. C. Case; Anatomischer Anzeiger, XIII, u. 4 & 5, 1897, p. 109. Jena.

In the second paper Dr. Baur in connection with Mr. E. C. Case, describes the best preserved skull of Dimetrodon yet obtained. The authors add some important points to the osteology of the Pelycosaurian skull, but curiously enough do not refer to the anticipation of many of their results in the description and figure of the nearly allied genus Naosaurus published by the reviewer in the year 1892 (Trans. Amer. Philos. Soc., p. 14, pl. II, figs. 7, 7a). They add to what is there stated the description of the bones of the preorbital region, and determine the entire distinctness of the supramastoid ("squamosal")

Ueber den Wirbelbau b. d. Reptilien u. e. a. Wirbelthieren, von A. Götte; Zeitschrift f. Wissensch. Zoologie, LXII, 3, 1896. Leipzic.

Psittacotherium, a Member of a New and Primitive Suborder of Edentata, by Dr. J. L. Wortman. From the Bulletin of the Amer. Mus. Nat. History New York, Nov., 1896, p. 259. The Ganodonta and their relation to the Edentata, by J. L. Wortman, M. D., loc. cit. pp. 59–1896.

The Stylinodontia, a Suborder of Eocene Edentates, by O. C. Marsh, Amer. Journ. Sci. Arts, 1897, Feb., p. 137. New Haven.

Contributions from the Zoological Laboratory of the University of Pennsylvania, No. VII.

element. They announce the presence of a supramastoid arch whose elements were shown to exist in Naosaurus in the paper above cited. They, however, show what I did not discover, that it is separated by a foramen from the postorbitosquamosal arch. This foramen is either not present in Naosaurus, or it has been closed by pressure in the specimen I described. They describe the palatal structure better than has been done hitherto, which turns out to be quite similar to that which I had shown to exist in the contemporary Cotylosaurian genus Pariotichus. It is important to notice here that the supramastoid is identified with the bone called by Baur in the Lacertilia the squamosal. This identification may well be questioned, since it is purely a roof bone in these paleozoic reptiles, while I have shown that Baur's squamosal enters into profound articulation with the cranial walls in the Mesozoic Pythonomorpha. And it is the latter that must explain the nature of Baur's "squamosal" in the Lacertilia, and not the more remote Paleozoic types. (See my discussion of this subject, AMERICAN NATURALIST, 1895, 855, 1003). But whatever the relations between these elements, neither is the squamosal of the Mammalia, which I can now show is the element which I have sometimes called supratemporal and which Baur calls prosquamosal.

As a phylogenetic inference they assert that the Pelycosauria cannot be arranged with the Anomodontia as a suborder of an order of Theromora, because in the Anomodontia there is only one postorbital bar. This, according to my definitions, is true, but supposing, that the Pelycosauria cannot be arranged with the Anomodontia on this ground, the statement that the Theromora "do not exist," is not justified. In 1869[4] the reviewer revised this order, and included in it the Placodontia, Proganosauria, Parasuchia, Anomodontia, Pelycosauria and Cotylosauria. In 1891[5] it was further revised by the inclusion of the Proterosauridæ. In 1894,[6] following the statements of Lydekker, that the Proganosauria (founded on Stereosternum and Mesosaurus only) is probably a Sauropterygian type, this group was omitted, and the Procolophonina of Seeley was inserted, the Cotylosauria and Pseudosuchia having been already eliminated. The name Proterosauria (Seeley) was retained to represent the suborder for which I had used the name Proganosauria, minus the Mesosauridæ (type of Proganosauria). The order thus constituted included the Placodontia, Proterosauria, Anomodontia, Theriodonta and Pelycosauria. I now add that it is probable that the groups discovered by Seeley in S. Africa called by him Gomphodontia and Cynodontia (which are, perhaps, not distinct from each other as suborders) belong to the Theromora. They coincide, in all important points, differing chiefly in dentition, a character in which the Theromora present as many types as the Marsupialia.

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[4] AMERICAN NATURALIST, October.

[5] Syllabus of Lectures on Vert. Paleontology, July, p. 37.

[6] Proceeds. Amer. Philos. Society, p. 110.

In view of these facts it became the duty of the authors of the present paper to retain the order Theromora, so long as others had preceded them in reconstructing it with the advance of discovery. Also in discussing the phylogeny the authors should do their predecessors the justice to quote their latest opinions, and not their earliest, which they had modified or abandoned. In the paper above cited,[7] and others, I advanced the hypothesis that the Mammalia were derived not from the suborder Pelycosauria, as I had at one time supposed (as cited by Baur and Case), but from the more comprehensive order Theromora, a conclusion to which they do not refer. In one paper[8] I remark, "The Pelycosauria *could not,* however, have given origin to the Prototheria, since in that class of mammals there is a well developed coracoid," etc.

The phylogenetic inferences of the authors may be learned from the following quotations. After citing my opinion of 1884 that "the mammalia are descendents of the Pelycosauria," they remark (p. 118) "It is quite evident that the Pelycosauria with the two temporal arches and the specialized neural spines cannot be the ancestors of the Mammalia; they represent a specialized side branch of a line leading from the Proganosauria to the Rhynchocephalia, which becomes extinct in the Permian." It must be remarked here that the specialized neural spines are not a character of the Pelycosauria, as some of the genera do not possess them; and I never introduced them into the diagnosis. The case is similar to that of the basilisks which have enormously elongate neural spines, yet the genus is one of the family Iguanidæ. It is, however, probable as Baur and Case remark, that the Pelycosauria should be excluded from the Theromora and be placed in close relation with the Rhynchocephalia, to which order I have already referred provisionally one of the genera (Diopeus). That the authors agree with me that the Mammalia are descended from the Theromora is evident from their conclusion that the former may have been derived from the suborders Gomphodontia and Cynodontia, which are Theromora. They say, "These forms look very much like mammals and could possibly be ancestral to them." It is thus evident that Baur's term Sauromammalia, which he never defined, is a synonym of Theromora. In describing the conditions necessary to define the ancestors of the Mammalia, the authors remark: "The mammals have a single temporal (zygomatic) arch; the posterior nares are placed far behind, and are roofed over by the maxillary and palatine plates; the quadrate is completely coössified with the squamosal and quadratojugal; the occipital condyle is double, and the entepicondylar foramen is present in all the generalized forms. The ancestors of mammals must show the same conditions." It is to be inferred from the context that the authors mean that the Reptilian ancestors of the mammals must show these conditions. Important exception must be taken to these statements. The palate is extensively fissured in some Marsupialia, while it is closed in the Placodont suborder of the Theromora. The complete coössification of the quadrate is not to be looked for in a Reptilian ancestor, but its reduction must. Such I have shown to be the case in the Pelycosauria, in Diopeus and Naosaurus, and Seely has shown it to be still more reduced in the Cynodontia. The other characters are found in one or another of the Theromora. Hence I believe that the opinion that I advanced in 1885, that the Theromora are the ancestors of the Mammalia is the correct one.

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[7] Transac. Amer. Philos. Soc., 1892, p. 25. Origin of the Fittest, 1887, p. 335–6, 346.

[8] Primary Factors Organ. Evolution, 1896, p. 88.

Some interesting "asides" are to be found in foot-notes to this paper. The authors state correctly that I described two temporal arches in *Diopeus leptocephalus* and, therefore, placed it in the order Rhynchocephalia, and stated that the Pelycosauria have only one arch, which is homologous with the zygomatic arch of mammals. They then add "It is interesting to note that the latter result was reached by Cope (1884) on the identical specimen of (Diopeus) *Clepsydrops leptocephalus.*" This statement, ascribing at the very least, gross carelessness to the author quoted, is throughout untrue. The ascription of a single temporal arch to the Pelycosauria was made by me in the original diagnosis of the suborder in 1880 (Proceeds. Amer. Philos. Soc., p. 38) four years previous to the discovery of the (*C.*) *D. leptocephalus* and in the description of the *C. natalis*, six years previously, in the statement "no quadratojugal arch." This means that the arch present, already described by me in *Clepsydrops natalis* in 1878 (Proceeds. Amer. Philos. Soc., p. 509) as a zygomatic arch, was still regarded by me as such.

In another foot-note the authors make the astonishing assertion that what I have called the columella auris in Diopeus is a rib. The skeleton of this specimen possesses ribs of the usual type, however, and neither in this genus nor in any other is there known a rib with a cup-shaped capitulum with a perforation of its peduncle. I have, moreover, figured a similar stapes in place in the allied genus Edaphosaurus (Transac. Amer. Philos. Soc., 1892, Pl. II, fig. 5a.) with perforation below the disc. No free head was observed in the latter genus, but it may be concealed.

Dr. Alex. Götte, the distinguished Professor of Leipzic, gives a detailed account of his researches on the embryology of the caudal vertebrae of certain existing Lacertilia, with the view of demonstrating that my doctrine that the intercentra of the caudal vertebræ of the Reptilia are not the homologues of the intercentra of the dorsal series of other vertebrates, and that the conclusion that the vertebral bodies of the Anamnia are chiefly composed of intercentra, while those of the Amniota are centra, is incorrect. He commences by misunderstanding the (p. 376) ground of the doctrine he seeks to overthrow, a very common cause of unnecessary polemic. He says: "The alleged homology of all described intercentra depends exclusively on the assumption that the continuity of the chevron bones with the perichordal bone above them, indicates their genetic identity, so that the latter are an expansion of the bases of the former, or reversed, the chevron bones are processes of the perichordal bones. On the contrary, I can, on the basis of my observations on the development of the saurian vertebra, assert as a fact, that a genetic identity of the intercentra with their inferior arches does not exist, and that these parts originate rather as distinctly separate, as the superior arches and their vertebral bodies." No contradiction of these facts can be justly derived from my papers on the subject, and if I have used the word "continuity" in describing the relations of the chevron bones with the caudal intercentra, it has been in the sense of homological continuity, as in the case of the superior arches and the pleurocentra. That this is true is apparently proved by the facts of paleontology. The ground which is fundamental in this connection is the fact, that the elements which in the genus Cricotus do support the chevron bones and do not, or only in part support the neural arches, and which may be identified by their contracted superior long diameter, are continued all the way through the sacral, dorsal and cervical regions from the caudal, so that the homology may be directly traced. And secondly, because in some species of Cricotus the upper part of the intercentrum in the dorsal region is so pinched as to reduce the body to the form, as it has the position of a large reptilian intercentrum.

Dr. Götte denies the homology of the caudal and dorsal intercentra and of different intercentra with each other on the following grounds. First, the centra of vertebrata are not homologous bodies; second, the chevron bones in Batrachia are primitively distinct from the caudal intercentra, and do not necessarily pertain to them; third, that in certain Lacertilia (e. g,, Anguis) the chevron bones are coössified with the centra, as is the case in the Batrachia Urodela; fourth, that the neural arches of the caudal vertebræ of Lacerta are partially divided on on each side by a fissure or foramen, which he regards as evidence that the vertebræ of reptiles consist of two original elements, that is, are produced by the fusion of the two bodies of the embolomerous type of column. His general conclusions are stated at the end of the paper as follows:

"(1). The construction of complete vertebræ with bodies and arches in the series of the Amiidæ, as in that of the Stegocephali and all living digitates begins in an embolomerous form, i. e., with double vertebræ to each segment. (2). The change of these double vertebræ into simple ones is accomplished by the fusion of the pairs after both vertebræ more or less, or especially the posterior one, have retrograded. (3). The rhachitomous vertebra is neither a primitive nor an independent appearance, but only a transitional stage in this change. (4). The principal significance of the embolomerous origin of the vertebra for the digitate vertebrates lies in the inheritance of certain remains of the double structure, the arches, transverse processes and ribs whose permanent forms are only to be understood on this ground."

As regards the question of the non-homology of the vertebral bodies, I believe that I have shown that they are for the most part not homologous as between the Anamnia and the Amniota, but that the homology of the contents of each of these divisions is shown by paleontologic evidence. It is also clear that many if not all of the vertebral bodies in the two great divisions in question must be homologous,otherwise we must have as many original ancestors of the vertebrata as there may be kinds of vertebral centra, a proposition which no one will be found to believe. In fact the embryology of forms of life of comparatively recent origin such as the Lacertilia, is apparently, from Göttes researches, as it should be supposed a priori, incompetent to explain the phylogeny of structures which received their definite completion in the paleozoic ages of time. *Owing to cenogeny, is is quite certain that structures may be directly related phylogenetically, which may appear to be in their present ontogeny not homologous.* This consideration applies to the supposed non-relation of the chevron bones to intercentra. This relation is universally demonstrated by paleontology, and better evidence than the changes of position in late forms such as occurs in Anguis (to which I have added Anniella) and the snakes, must be cited to invalidate it.

As regards the precedence of the rhachitomous over the embolomerous type of vertebral column, paleontologic evidence demonstrates that this was the history as regards Teleostomous fishes and Digitata (or Amniota), as Zittel has shown to have been the case in the former and I have shown as to the latter. Embolomerous forms do not come first in geologic time in these divisions, but later. I have not made any attempt to interpret with respect to this hypothesis, the structure of the vertebral column in the Selachii. They afford, however, no support to Prof. Götte's hypothesis, since it is probable that the Selachian vertebral column originated in a rhachitomous condition. In notochordal sharks, e. g., the Ichthyotomi, the primitive vertebræ are represented by centra above and intercentra below, as in the Teleostomi and Stegocephali. The superior segment supports the neural arch, and the inferior the hæmal arch. Götte's first proposition, that the embolomerous condition is the primitive one, is shown to be untrue as to the true fishes by the facts adduced by Zittel and others, since the primitive vertebræ of fishes described by these authors is rhachitomous and not embolomerous. Prof. Götte does not observe that his fig. 6 (text, p. 384) of Callopterus, represent rhachitomous caudal vertebræ, and dorsal vertebræ in which the centrum (pleurocentrum) is greatly reduced, so that the intercentrum becomes by far the larger part of the vertebral body. This is in exact accord with what is found in the Stegocephali, and is contributive evidence that the vertebral body in the Anamnia is intercentrum. That the body in the Amniota is centrum is abundantly proven by the characters of the Permian Pelycosauria.

In this study we have again an excellent illustration of the relative value of embryologic and paleontologic research in determining the homologies of parts and phylogenies of types. As to this Prof. Goette expresses himself thus (p. 377): "Since these relations can only be directly observed or completely known in living animals, and not in the fossil Stegocephali, so it is a self evident proposition that the unknown can only be explained by the known, the extinct by the living animals." This proposition must now, in view of the results of modern research be reversed so as to read as follows: *Since these relations can only be completely known or directly observed in fossil animals, and not in the embryonic history of living forms, it is a self evident proposition that the unknown can only be explained by the known, the living by the extinct animals.* Conceding the great value of embryology in the premises, it has now become fully evident that it can only be understood when interpreted by paleontology. An excellent illustration is the case of the embryology of the vertebræ of Amia, described by Hay and

Gadow, the former of which is discussed by Götte. The two researches only agree in discovering a much greater complexity in the ontogeny of these vertebræ than paleontology gives the least ground for supposing to have ever existed in the adult types of extinct Teleostomous fishes.

In his papers on primitive Edentata Dr. J. L. Wortman describes more fully than heretofore on new material, characters of the genus Psittacotherium Cope. He finds that it is armed with robust compressed claws, and that the foot is short and megatheroid in appearance. He interprets the dentition in a new way, and then homologizes with it the dentition of the genera Hemiganus and Ectoganus. The teeth formerly described as incisors in these genera he regards as canines. To these he adds Stylinodon Marsh, to form a family Stylinodontidæ. The genera Onychodectes and Conoryctes Cope he places in a family Conoryctidæ. Both he combines into a suborder Ganodonta of the order Edentata.

Whether the interpretation of the dentition of Psittacotherium and Ectoganus is correct or not depends on the interpretation of the same parts in Calamodon. Some doubt must still remain as to this point, a doubt which I have always felt. It is certainly not unlikely that Dr. Wortman's interpretation may turn out to be correct, and if true, a clearing up of the subject of the relation of these forms to the Tillodonta of Marsh will result. Accepting his view as correct, we have then a group having strong claims to being regarded as ancestral to the Edentata. This position I maintained as long ago as 1875, when (in the Report of the U. S. Geol. Geogr. Surv. W. of 100th mer., Vol. IV) I included some of these forms (Ectoganus and Calamodon) in a suborder Tæniodonta, and suggesting its ancestral relation to the Edentata. I have not pressed this view recently for the reason above referred to. The name was, however, given, and it was applied to a group so far equivalent to Wortman's name Ganodonta, that as matter of taxonomic rule it cannot well be displaced. His reasons for rejecting the name are that I referred two of the genera (Conoryctes and Onychodectes) to the Creodonta, which I still do; that I failed to recognize the affinities between Calamodon and Stylinodon, which, however, I always have done so far as the imperfect description of Marsh would permit. Thus, in my Synopsis of Families of Vertebrata, AMERICAN NATURALIST, October, 1889, I place in the suborder Tæniodonta, the two families Ectoganidae and Stylinodontidae. Wortman concludes also that the name must be rejected because founded in error. If this be true, it is no reason for the rejection ; on the same ground nearly every name in Biology above the specific would have to be rejected.

Although Dr. Wortman makes excellent use of the material at his disposal, and throws much light on the characters of some of the genera, the evidence for the reference of the Tæniodonta to the order Edentata, must be considered as yet very obscure. But the reference to that order of Conoryctes and Onychodectes is still more difficult, if not impossible. If proper, a new definition of the Edentata must be forthcoming. I am still of the opinion that the best provisional place for these two genera is in the Creodonta, next the Tæniodonta, to which they have probable affinities. The position of Dr. Wortman is based on the scientifically untenable assumption that because forms probably stand in the relation of ancestor and descendent they must therefore belong to the same genus, family, order, etc. He goes so far as to place Esthonyx in the Tillodonta, to which it is probably ancestral, although it does not possess the essential character of that order or suborder—incisors growing from persistent pulps. For equally valid reasons all the genera of a phyletic line might be regarded as a single genus. This kind of formulation casts to the winds all taxonomy, and the effect of it is seen in this instance in Dr. Wortman's failure to define the order Edentata. It was the consideration of such forms as Conoryctes and Onychodectes with Esthonyx and the Tæniodonta and certain Insectivora, that led me to propose the comprehensive order of Bunotheria, which is the source of all the Unguiculate orders of later time.

Professor Marsh's article is a much needed description of his genus Stylinodon, of which he has obtained some important parts of the skeleton. It looks more like an Edentate than any of the other Tæniodonta, with which I placed it in 1889. The figures which he gives, will prove valuable to paleontologists, but more light will be necessary before its relation to the Edentata can be determined. Prof. Marsh cannot let the opportunity pass without proposing a new subordinal name, "Stylinodontia," which he does not characterize, although there are already two other names in the field before him, one of which, Tæniodonta, was proposed and defined twenty-one years ago. The rambling discussion as to the origin of the Edentata which closes this paper adds nothing to our knowledge of the subject, especially as it includes the names of genera which he has never defined, and which are so far unknown to science.—E. D. Cope.

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General Notes.

PETROGRAPHY.[1]

Italian Petrography.—The third part of Washington's[2] paper on Italian petrography deals with the Bracciano, Cerveteri and Tolfa districts. The products of the Bracciano volcano may be separated into a leucitic and a non-leucitic group. The non-leucitic rocks contain orthoclase and basic plagioclase, in this respect resembling the vulsinites and the ciminites, but they are more acid than these types, containing sometimes as much as 72 per cent. of SiO_2 a part of which separates as quartz. They resemble the quartz-trachytes of Tuscany, and thus occupy the position in Brögger's classification reserved for the quartz-trachyte-andesites. The author calls the members of the group toscanites. The leucite rocks of this volcanic center embrace leucitites, leucite-tephrite and leucite-phonolite.

The rocks of the Cerveteri district are toscanites and leucitites, and of the Tolfa district, toscanites.

An analysis of the toscanite of Castle Hill, Tolfa, follows :

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O		Total
65.19	16.04	1.16	2.48	.99	2.92	2.26	6.11	1.85	=	99.00

The Quartz-Porphyry in the Ruhr Valley, Westphalia.—This rock has been described several times by geologists, but it has been reserved for Mügge[3] to investigate it microscopically. It occurs in massive and in schistose phases and in the form of a breccia associated with schists. The massive variety resembles, in many respects, a gneiss. It is banded in light and dark irregular bands. Spherulites united by what was once a glassy matrix marked by perlitic cracks constitute the groundmass in which phenocrysts of quartz and orthoclase are imbedded. The rock has suffered profound mechanical and chemical alterations. The quartz grains are crossed by fine lamellae extinguishing in different positions, and by others extinguishing nearly together. The latter are visible in ordinary light. They are phenomena of translation.[4] The groundmass is filled with tiny veins of quartz, stringers of a sericite-chlorite aggregate and nests of quartz and newly formed feldspar. The schistose porphyries differ from the more massive ones in the greater degree of their alteration. Analyses of the two types follow:

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Jour. of Geology, Vol. V, p. 34.

[3] Neues Jahrb. f. Min., etc., B. B. X, p. 757.

[4] Cf. Neues Jahrb. f. Minn., etc., 1892, II, p. 95, 98, 1895, p. 213.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	Total
Massive	76.50	15.68	.78				1.10	4.92	.88	= 99.76
Schistose	72.08	16.15	2.21		.18	.68	5.23	.21	2.40	= 99.14

The porphyry breccias consist of fragments of porphyry and of schists in a foliated matrix composed largely of porphyry and schist débris. In origin they are believed to be reibung's-breccias formed at the juncture of schist and porphyry. The paper is handsomely illustrated with photo-lithographs of thin sections.

The Eclogite of the Fichtelgebirge.—Newland[5] gives a few notes on the eclogites comprising a portion of the central gneissic cone of the Bavarian Fichtelgebirge. Mineralogically, the eclogite is so varied in composition that the rock is very difficult to define. Its most characteristic component is garnet, but, in addition to this, it contains also omphacite, hornblende, cyanite, zoisite, sphene, andesine, muscovite, zircon, pyrites, magnetite, rutile, quartz, and a few other minerals. No olivine could be found in any of the sections, although it was searched for. The pyroxene, hornblende and feldspar are often arranged in intergrowths resembling granophyre, and the pyroxene or garnet is surrounded by a radial aggregate of feldspar, hornblende and omphacite, which, under low powers, looks like a reaction rim. Analyses of the rock indicate that it is nearly allied to certain types of eruptives. (I) represents the composition of the eclogite from Markt Schorgast, and (II) that of a diabase from Fichtelberg:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	CO_2	Total
I.	48.81	16.25	6.00	7.48	.43	9.72	7.12	.46	2.64	.12		— 99.03
II.	47.60	15.29	7.09	6.87	.12	8.41	6.48	1.40	3.62	2.14	.16	— 99.18

Nodular Granite from Finland.—Frosterus[6] describes a new nodular granite from Kangasnierni Parish in Finland. The rock was found as boulders in morainal deposits. It is a biotite-granite in which the nodules are thickly strewn. Each nodule is composed of three quite distinct parts—an inner nucleus of biotite, sometimes with a fragmental outline, surrounded by a zone of coarse granite and an outer zone of fine-grained granite. Outside of these are several distinct envelopes, the inner of which consists principally of feldspar and the outer of biotite and feldspar. In the envelopes the feldspar is radially

[5] Trans. N. Y. Ac. Sciences, Oct., 1896, p. 24.

[6] Bull. Com. Geol. d. la Finlande, No. 4, p. 1.

arranged. The author describes in detail the features of the different portions of the nodules and illustrates them with some handsome figures. The central parts of the nodules are believed to be inclusions of gneiss that have been affected by magmatic alterations. Surrounding these is a zone composed of a coarse aggregate of andesine, quartz, microline and other components of a normal granite, next a zone of a fine grained and radial aggregate of biotite, plagioclase, orthoclase and quartz, and finally the concentric shells. The zones surrounding the nucleus are thought to be due to contact action between the granite and the included gneiss. The inner concentric shell is composed of plagioclase, quartz, orthoclase and biotite on the inner side and principally microcline on the outer side. The outer shell is fine grained, and is composed of biotite, orthoclase, plagioclase and quartz. The rock surrounding the nodules possesses no special features different from those of normal granitites. Its material grades into that of the nodules.

Analyses show clearly an increase in acidity from center to periphery of the nodules, which are, on the whole, more acid than the mother-rock. After discussing the origin of similar structural phenomena in other rocks, the author concludes that the nodules in the Finland granite are due to crystallization around the centers of crystallization afforded by the inclusions of gneiss.

Volcanic Ash from the North Shore of Lake Superior.—N. H. Winchell and U. S. Grant[7] report the existence of volcanic ashes in the Keweenawan series near Duluth. The rocks in question resemble fine grained impure sandstone. They are associated with diabases, basalts and rhyolites. In thin section they are found to be composed of fragments, apparently of vesicular lavas, in a matrix consisting of a secondary aggregate of quartz, feldspar, chlorite, epidote, calcite and iron oxides. A few of the fragments show traces of perlitic parting.

The Diabases of Goslar.—The diabases in the middle Devonian schists of Goslar in the Harz are discussed by Rinne.[8] The rocks are always in the form of sheets interleaved with the schists. Most of these are intrusive, but, in a few instances, volcanic bombs and other evidences of the presence of surface volcanic products indicate the existence of active volcanoes in the district, though diabase tuffs have not been found. From the general appearance of the upper surface of some of the sheets there can be no doubt but that they were lavas.

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[7] Amer. Geol., Vol. XVIII, p. 211.

[8] Neues Jahrb. f. Min., etc., B. B. X, p. 363.

The bombs are found strewn through the schists associated with the diabase. Their macroscopic features are carefully described with the aid of a number of figures. Some of the sheets are porphyritic with phenocrysts of irregularly outlined oligoclase surrounded by micas in a groundmass with the composition of normal diabase. The augite in this groundmass is sometimes idiomorphic, and in nearly all cases it is bordered by a rim of hornblende; often the hornblende replaces feldspar laths embedded in the pyroxene, forming of them complete pseudomorphs. The augite is replaced by calcite in some specimens, and by chlorite in others.

The four structural types recognized by the author are: compact gabbroitic phases, compact ophitic varieties, compact porphyritic kinds and amygdaloidal varieties. The gabbroitic diabases are all gabbrolike in the land specimen. In thin section the feldspar grains break up into an aggregate of feldspar laths. The ophitic diabases present no unusual features except that in the coarse grained varieties the large feldspar grains are filled with inclusions of the other components. The amygdaloids are sometimes porphyritic, more frequently normal. On the contact between the diabase and the schists, both rocks have suffered from the effects of contact action. The diabase is much denser near the contact than at a greater distance from it, and in places is much altered, quartz being an abundant product of this alteration The schists, which are mainly roofing slates, are crystallized near their contact with the eruptives.

MINERALOGY.[1]

The Production of Precious Stones in 1895.—Under this title Kunz[2] reviews the chief features of the gem industry for the year, giving specially copious details concerning the American production.

A six-carat diamond was found at Saukville, Wis., six miles from Milwaukee. In California several diamonds were found, one at Alpine Creek, Tulare Co., five near Oroville, Butte Co., and about as many more from near the "head of the creek," probably referring to one of the sources of the Feather River. From the association with peridotite, it seems probable that more may be found in this region.

In South Africa the De Beers Company produced diamonds to the value of about $15,000,000 in the year ending July 1, 1895, and the

[1] Edited by Prof. A. C. Gill, Cornell University, Ithaca, N. Y.

[2] Seventeenth Annual Report of the U. S. Geol. Survey, 1896, pp. 895–926.

output of the same company for 1896 has been sold for $26,000,000. The total of the dividends paid by the South African diamond companies in the past ten years has been $58,000,000. A 640 carat diamond called the Rietz, found in 1895 is superior in quality to the Excelsior (971 carats) discovered a year or two earlier. The extent of the South African deposits is much greater than hitherto supposed, and many new workings are being opened. Near Winburg, in the Orange Free State, diamond diggings of a prehistoric race were discovered.

Stonier states that the diamonds of New South Wales occur in a Tertiary (?) deposit, and may have been derived from an intrusive mass of peridotite, now serpentinized. They are said to be of better quality than those from South Africa.

The great advance in the price of carbonado, which has trebled in value, has stimulated the search for substitutes. The only source of carbonado is Bahia, Brazil, where a single lump weighing 3,073 carats was found during the year. The practicability of using artificial diamonds seems improbable in the light of Moissan's experiments, who has made several hundred crystals with a total weight of about ½ carat on an outlay of $2000. This is about 2000 times the value of natural diamond powder.

Mr. Kunz has named the hydrocarbon to which the phosphorescence of certain diamonds is attributed, *Tiffanyite.*[3]

Rubies have been found in place near Franklin, Macon Co., N. C., in decomposed gneiss with garnets and chlorite.

Brown and Judd[4] have recently described the occurrence and methods of obtaining the rubies of the noted Burmese mines, where the paragenesis is much like that of the corundum at Orange Co., N. Y., and Sussex Co., N. J. In Siam rubies and sapphires have been obtained during the past few years from the Patat Hills. From Black Creek, New Zealand, rubies are also reported. Sapphires and a few rubies are gotten by sluicing the detritus of a decomposed limestone in Fergus Co., Montana. The outlook in this locality is promising. The Montana rubies and sapphires are extremely varied in color.

A number of rich green tourmalines were found in 1895 at Mt. Mica, Paris, Me. Five of these were cut into gems of from five to fifty-seven carats in weight. At Haddam Neck, Conn., five hundred dollars worth of tourmalines of various colors were obtained.

Turquoise is reported from Cripple Creek and from Castle Rock Spring, Col. A mixture of prosopite and quartz closely resembling turquoise was found at Provo, Utah.

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[3] Trans. N. Y. Acad. Sci., May 20, 1895, p. 260.

[4] Phil. Trans., Vol. 187, A, pp. 151–228.

Unusually fine opals from near Salmon City, Idaho, as well as other occurrences of opal in Idaho, Washington, Oregon, Arizona, California, Colorado and Georgia are mentioned. Australian opals were sold for more than $100,000 in 1896.

In addition to the above named gems, mention is made at greater or less length of andalusite, cyanite, garnet, quartz, amethyst, chrysoprase, plasma, moss agate, labradorite, lapis lazuli, rhodochrosite, realgar, amber, xenotime and monazite.

The total value of the gem production in the United States for 1895 is placed at $113,621, of which $50,000 is accredited to turquoise.

The Coloring Matter of Minerals.—The cause of the varied colors of certain minerals is discussed by Weinschenk,[5] who presents a large number of facts tending to show that these colors are much less frequently due to organic substances than has been hitherto assumed. From considerations of the paragenesis of minerals, it is suggested that compounds of the elements tin, zirconium, titanium, cerium, didimium, lanthanum, nickel, tantalum and beryllium are in many cases more likely to be the true source of the minerals' colors. The effect of the cathode rays and X-rays in producing a similar color in minerals, even in some cases where the color had been previously destroyed by heating, is cited as evidence against the organic nature of the coloring matter (?). The occurrence of colored minerals as a result of the cooling of a fused magma is evidence in the same direction. The suggestion is thrown out that the color of certain minerals may be a valuable index to the conditions of their origin, when investigation shall have determined the true cause of the color.

Pearceite and Polybasite.—The systematic working out of the relationships existing between various isomorphous minerals has received another important contribution from Penfield.[6] Hitherto the name polybasite has been applied to a group of minerals whose chemical composition is of the type seen in the formula $Ag_9 SbS_6$, in which Ag is partly replaced by Cu, Fe or Zn, while the isomorphous arsenic molecules may occur in any proportion, almost to total replacement of antimony by arsenic in some specimens. The new name *Pearceite* is proposed in honor of Dr. Richard Pearce of Denver, Col., for the sulpharsenite, while the old name polybasite is restricted in its application to the sulphantimonite.

[5] Zeitschr. d. D. geol. Ges., XLVIII, pp. 704–712, 1896.

[6] Am. Jour. Sci., CLII, pp. 17–29, July, 1896.

Pearceite is monoclinic; $\grave{a}:\bar{b}:c'=1.7309:1:1.6199$; $\beta=89° \ 51'$. The crystals have usually a hexagonal aspect. They are black in color with metallic lustre, hardness 3, and specific gravity about 6.15. It is suggested that the high percentage of copper—more than 18%—may account for the opacity of pearceite. It is very easily fusible and gives readily test reactions for its component elements. The pearceite specially studied occurs with quartz, calcite and chalcopyrite at the Drumlummon mine, Lewis and Clarke Co., Montana.

A careful study of the crystal form of polybasite leads to the conclusion that it also is monoclinic instead of orthorhombic or rhombohedral as previously supposed. The axial ratio $\grave{a}:\bar{b}:c'=1.7309:1:1.5796$; $\beta=90°$.

Perhaps the most interesting part of the paper is the comparison of pearceite and polybasite with each other and with certain other more or less allied minerals. From this it appears that arsenic compounds have a slightly longer vertical axis than the corresponding antimony minerals. Five cases are cited to illustrate this. Attention is also called to the fact that the prismatic angle is nearly 60° as a rule, and that in this respect chalcocite, Cu_2S, and stromeyerite, $Cu\,AgS$, closely resemble the sulpho-salts.

Miscellaneous Notes.—Davison[7] gives the name *Wardite* to a mineral which appears from a partial analysis to consist largely of a hydrous basic phosphate of aluminum. It occurs with the Utah variscite, and may be allied to turquoise and peganite.——More careful study of the percussion figure of the micas by Walker[8] discloses the fact that the angle between the rays varies in some instances very considerably from 60°. Muscovite showed an angle of 52° 53′ to 55° 57′, lepidolite 59° 7′ to 60° 12′, biotite about 60°, and phlogopite 60° 52′ to 63° 28′.——On five crystal fragments of the mineral leonite, $MgK_2(SO_4)_2+4H_2O$, Tenne[9] determined its crystal form to be monoclinic, with the axial ratio $\grave{a}:\bar{b}:c'=1.03815:1:1.23349$, and $\beta=84° \ 50'$. This is a considerable variation from the crystal form of blödite, which has the analogous composition $Mg\,Na_2\,(SO_4)_2+4H_2O$. The latter mineral is also monoclinic, but its axial ratio is $\grave{a}:\bar{b}:c'=1.3494:1:.6715$, and $\beta=79° \ 16'$.

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[7] Am. Jour. Sci., CLII, pp. 154, 155, 1896.

[8] Am. Jour. Sci., CLII, pp. 5–7, 1896.

[9] Zeitschr. d. D. geol. Ges., XLVIII, pp. 632–637, 1896.

GEOLOGY AND PALEONTOLOGY.

Alleged Fossil Micrococci.—M. B. Renault communicates to the Academy of Sciences (Paris) a note concerning certain Micrococci and Bacilli which he has found in Coal-Measures of Saint-Etienne and of Commentry. They occur in these formations in considerably larger quantities than they do in plants preserved in flint or in carbonate of lime. They are, moreover, less varied in form and dimensions than are those found in silicified plants, and they are not so much carbonized as the plants in which they are found. (Revue Scient., Dec., 1896.) Any positive determination of such objects as are figured and described by M. Renault must, however, be regarded with suspicion, and some new light must be obtained on the process of fossilization before fossil Micrococci can be made credible.

Geology of Luang Prabang.[1]—The observations made by MM. Counillou and Massie during their stay at Luang Prabang, as members of the Pavie Mission, show the following facts:

(1) The existence in the vicinity of the region studied of Productus and Schwagerina limestones, which are the equivalent of the Moulmein (Birmaine) beds, or one of the terms of the Salt Range series, and, perhaps, of the limestones of Sumatra.

(2) The presence, to the northwest of Luang Prabang, of a system of red clays, limestones and graywackes belonging to the Permian period, and exceedingly like the upper part of the Raingung group (India).

(3) The existence of a formation of purple clays and sandstones, beginning with a pudding-stone, and containing remains of Dicynodonts. Up to the present time these reptiles have been discovered only in the Karoo beds of South Africa, the Panchet of India and the Elgin of Scotland. It is natural then to consider this formation as constituting in Laos the base of the Trias.

(4) As to the limestone of Luang Prabang, although these two geologists believe its position to be inferior to the red clays, they cannot determine its exact age for want of sufficient stratigraphic and paleontologic data. (Revue Scientif., Jan., 1897.)

The Position of the Chico-Tejon Beds.—Since the discovery of the Chico-Tejon series of marine beds on the Pacific coast by Conrad, in 1855, there has been much debate over the determination of the age of the series. They were thought at one time to constitute transition beds between the Cretaceous and Eocene. After a critical study of the faunal relations of the series in question, Prof. T. W. Stanton arrives at the following conclusions:

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[1] Luang Prabang is situated on the left bank of the Mekong, in Coachinchina, 99° 45′ long. E. and 19° 54′ 20″ lat. N.

"1. In all known sections that contain both Chico and Tejon the strata are apparently conformable. So far as it goes, this is an indication of continuous sedimentation; but without further evidence it cannot be accepted as proof that there is no break, nor should it be given greater weight than the clear unconformability between Tejon and older Cretaceous beds in Oregon.

"2. The Martinez group of the California Survey is not a simple formation that can be considered a mere subdivision of the Chico, but consists of two distinct portions, one of which is Cretaceous and inseparable from the Chico, while the other is Eocene, and is here classed as Lower Tejon.

"3. The 'intermediate beds,' supposed by Gabb to form a transition from the Chico to the Tejon, are the same as the upper part of the Martinez group and the Lower Tejon. Their fauna, so far as known, includes no distinctively Mesozoic elements.

"4. The Chico fauna is characteristically Cretaceous, its so-called 'Tertiary types' being persistent or modern types that have changed but little from the Cretaceous to the present day.

"5. An examination of the species supposed to occur in both the Chico and the Tejon reduces their number to not more than six, and with one exception those are all persistent types that cannot be classed as Mesozoic. The exception is *Ammonites jugalis*, which Gabb collected from two localities supposed to be Tejon in the Mount Diablo region, but it has not been rediscovered in any subsequent Tejon collections. The Ammonoid seen by Heilprin in the Gabb collection from Fort Tejon may or may not be this species. It is held that the Tejon fauna is essentially Eocene and very distinct from the Chico, even though this ammonite should prove to belong to it.

"6. The time interval indicated by the decided change in faunas from the Chico to the Tejon cannot now be estimated. In fact, there is little evidence that the latter fauna is derived from the earlier, excepting in a few species; and it is possible that all the changes took place by extinction and migration of species during the period in which the barren beds between the latest Chico and the earliest Tejon fossiliferous horizons were laid down. It will not be surprising, however, if evidence is sometime found of a period of erosion at the close of the Cretaceous on the Pacific coast." (Seventeenth Ann. Rept. U. S. Geol. Surv., 1895–96, Pt. I, 1896.)

The Position of the Periptychidæ.—This family is one of the three which I placed in the Condylarthra on the establishment of that order, the two others being the Phenacodontidæ and the Menscotheriidæ. With regard to its phylogenetic position, I adopted the view that it is probably the type from which were derived the order Amblypoda. In a synopsis of the latter order, published in 1884,[2] I remark (p. 1129), "It was not until later (1877) that I assumed that the Diplarthra are descendants of the Amblypoda, although not of either of the known orders, but of a theoretical division with bunodont teeth. That such a group has existed is rendered extremely probable, in view of the existence of the bunodont Proboscidia and Condylarthra. This hypothetical suborder has been called Amblypoda Hyodonta." * * "The existence of Amblypoda Hyodonta is rendered almost certain by the discovery that the genus Trigonolestes[3] of the Wasatch epoch is an artiodactyle with tritubercular bunodont superior molars. The ancestral type of such a form must have been a tritubercular bunodont amblypod. Pantolambda is such a form with the tubercles modified into Vs. Moreover, such a type (Amblypoda Hyodonta) would be derived from a a Periptychid Taxeopod, with but little modification of the latter. A distinct facet of the astragulus for the cuboid bone, and probably a change of the carpus by an articulation of the unciform and lunar bones would be all that would be necessary. The discovery of Pantolambda has increased the probability of such a change having taken place in the hind foot, since the astragalus is intermediate in form between those of Coryphodon and Periptychus."

I have never concealed from myself the possibility that the Periptychidæ themselves might prove to be the Amblypoda Hyodonta. The astragulus has a considerable articulation with the cuboid bone, which has an obscure angular distinction from the facet for the navicular. So far as this articulation goes the family might be placed in the Amblypoda. I have awaited the discovery of the carpus of the Periptychidæ from that day to this (seventeen years); but success has not attended the efforts of Osborn and Wortman, who have searched for it. It is now, however, time to remark, that as there has been no other type discovered which could represent the Amblypoda Hyodonta, the probability that the Periptychidæ are that type, is increased. It is eminently probable that, since the alternation in the tarsus in that family is undoubted, it will also be found to exist in the carpus, as required for the missing type. Should this prove to be the case, the Periptychidæ must be removed from the order Condylarthra to the Amblypoda, where it will form the second family of the suborder Taligrada, the other family being the Pantolambdidæ. The two families will differ in this, that in the Periptychidæ the molars are bunodont, while in the Pantolambdidæ they are primitively selenodont, or with V-shaped cusps. This arrangement, if correct, puts the Periptychidæ in direct ancestral relationship to the Diplarthra, and so far confirms Schlosser's hypothesis that that family is the ancestor of the Artiodactyla. This view is also in accordance with that expressed by Osborn and Earle in their important paper on the Fossil Mammals of the Puerco: Bull. Am. Mus. Nat. Hist. New York, 1895, p. 47.

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[2] AMERICAN NATURALIST, 1884, p. 1110.

[3] "Pantolestes" in the original=*Trigonolestes brachystomus,* which is not a Pantolestes.

The families of the Condylarthra will be, in that case, the Phenacodontidæ and the Menscotheriidæ, and the Pleuraspidotheriidæ of Lemoine, if the last be different as a family from both of the others. —E. D. Cope.

Glacial Beaches of Michigan.—During the past year Mr. F. B. Taylor has made a study of the moraines, abandoned beaches and outlets of the glacial lakes which formerly occupied the southern part of the lower peninsula of Michigan. His conclusions are as follows:

The glacial waters that gathered in the Erie, Huron and Ontario basins during the retreat of the ice-sheet underwent many changes. In falling from their highest level to the present level of Lake Erie the glacial waters changed the place of their outlet four or five times. At each change they paused for a time, sufficient to make a distinct beach. For the whole series of lakes the author would propose a descriptive,

Stages.	Lakes.	Beaches.	Outlets.	Moraines.
1	Maumee	Van Wert	Fort Wayne	Defiance.
2	Unnamed	Leipsic	Imlay	Toledo and Detroit.
3	Whittlesay	Belmore	Tyre Ubly	Port Huron, Saginaw.
4	Unnamed	Arkona	Undecided	Undecided.
5	Warren	Forest	Pewamo	Undecided.

(Bull. Geol. Soc. Amer., Vol. 8, 1897).

general name, as the Erie-Huron lakes, and for each separate stage having a separate outlet a particular name. Mr. Taylor's especial contribution to science in this paper is the discovery of certain outlets and the correlation of the shore-lines (as shown by the beaches), the outlets, and the retaining dams (indicated by the moraines) of the separate lakes. The relations of these features to each other are discussed in detail, but may be indicated by the table on page 336.

Lake Agassiz.—Mr. J. B. Tyrrell suggests that Lake Agassiz had its beginning as follows: Starting with the Dawson idea of three great centers of snow and ice on the North American continent during the glacial period, he traces the history of the centre great glacier (Kewatin) which originated northwest of Hudson Bay. A portion of this glacier occupied the basin of Lake Winnipeg and the Red River Valley for a long time. As it retired a portion of the eastern or Laurentide glacier was advancing. The Kewatin glacier seems to have retired northward well into Manitoba, and possibly even beyond the northern limit of that province, before it was joined by the eastern glacier. When they united the water was ponded between the fronts of the two glaciers to the north and east, and the high land to the south and west. Such is the origin of Lake Agassiz. Its waters rapidly rose until they overflowed southward into the valley of the Mississippi, and then gradually declined as the river Warren deepened its channel. (Journ. Geol., Vol. IV, 1896).

The Prehistoric Dog.—M. Th. Studer, of Berne, has presented an interesting work to the *Soc. helvetique des sci. nat.* on the races of dogs found in the lacustrine deposits of the Stone Age. These are *Canis palustris*, a small species dating from the neolithic; a large dog found in Lake Ladoga and Lake Neuchatel, which is related to the Siberian sledge-dog; and *Canis familiaris Leineri*, a large, slender dog, reminding one of the Scottish greyhound.

The shepherd dog appeared in the Age of Bronze, and also a hunting dog (*Canis familiaris matris-optimœ* and *Canis fam. intermedius*). These different races have a common palearctic origin. The Mediterranean and Egyptian races are derived from a different type of equatorial origin. (Revue Scientif., Jan., 1897).

Geological News.—MESOZOIC.—The Museum of Lyon publishes in its Archives the drawings made by M. Jourdan, of a series of singular organisms which he classed as Echinoderms under the names *Pegmacrinus cupulatus*, *P. radiatus*, *P. inflatus* and *P. gracilis*. Since Mr. Jourdan's death these organisms have been much in dispute; zoologists refuse them a place among Echinoderms, and botanists deny their being calcareous algæ. On the same plate are figured two fine Echinoderms from Cirin. They are described by M. P. de Loriol. (Arch. Mus. d'hist. nat., Lyon, T. 16, 1895).

A new fossil fish reported by Mr. R. Storms from the bruxellien sandstone is remarkable for its size. It is referred to the genus Cybium with the specific name *proostii.* Its mandible measures 34 centimeters. If its proportions correspond with the modern *C. regale*, its total length must have been not less than 2.55 m., or double that of *C. bleekerii*, found in the same formation. (Bull. Soc. Belge de Geol., T. IX, [1895] 1897).

CENOZOIC.—Nine new species and varteties of Ostracodâ from the Pliocene beds near Berkeley, California, are described and figured by Mr. Frederick Chapman. The specimens are such as inhabit fresh water at the present day, with the exception of one, a Cypripopsis, which is as often found in brackish water. They are all comprised in the family of the Cypridæ. It is suggested by Dr. Merriam that the Ostracoda may be of use in determining horizons of the Berkeley Pliocene beds. (Bull. Dept. Geol., Univ. Calif., Vol. 2, 1896).

An interesting bone breccia was discovered some months ago in the neighborhood of the Wombeyan caves, New South Wales, by Mr. R. Broom. The deposit is old, and contains a few new forms, 5 of which are described in the Proceeds. Linn. Soc., N. S. W. According to the author this 1895–96 collection from this deposit gives a fair idea of the smaller animals living in later Tertiary times. One of the important discoveries was that of *Dromicia nana*, represented by a number of both lower and upper jaws. This find establishes Thomas' theory that Dromicia existed formerly in Eastern Australia. Mr. Broom considers it probable *D. nana* still survives in the district of the Wombeyan caves. (Proceeds. Linn. Soc., N. S. W., 1896).

The fossil bones of several species of monkeys found in the caves of Brazil by Lund have been recently described by M. H. Winge. With one exception the species are still existing, and are found in the same localities to-day. The one extinct species, to which M. Winge gives the name *Eriodes protopithecus*, is represented by several detached bones, which cannot be referred to one individual, but which, without doubt, can be referred to the same species. The new form resembles *E. arachnoides*, having the same long, slender limbs, but shorter fingers, and the measurements show that it must have been a very much larger animal than its living relative. (E. Museo Lundii, Kjobenhavn, 1895–96).

BOTANY.[1]

New Species of Fungi from Various Localities.—The following new species of fungi have been received from various localities in North America within the past few months:

Polyporus subluteus E. & E. On decaying beech, London, Canada, November, 1896 (Dearness, 699c). Effused with the upper margin more or less reflexed, margin or surface of the pores light yellow (when dry), substance soft and pliable, pilei about 1 cm. long by 3–4 cm. broad, white, short-tomentose, zoneless, subimbricate, margins obtuse, flesh thin, white, of woolly-floccose texture, not at all fibrous. Pores uneven, subcolliculose, unequal in size, round or subsinuous, ⅓–¾ mm. diam., ¾–1 cm. long, margin subdentate, dissepiments thin. Spores oblong, a little narrower at one end, white 4–6 x 1½–2μ. The pores, like the flesh of the pileus, are white inside.

Poria subviolacea E. & E. Underside of decaying oak limbs, lying on the ground, Newfield, N. J., September and October, 1896.

Subiculum archnoid-tomentose, white, loose, not separable from the matrix, hymenium at first violet-color with the pores mere hemispherical depressions, but the violet soon fades to dirty white, or yellowish-white, and the pores become more elongated, but still short, more or less irregular in shape, with the margins dentate. Spores allantoid, hyaline, 3½ x 1μ. Soft, juicy and flexible when fresh.

Favolus striatulus E. & E. On rotten limbs in woods, Mt. Cuba, Delaware, July, 1896 (Commons, No. 2781).

Stipitate. Pileus convex-plane, firm and rigid when dry, umbilicate, radiate-striate with fine, more deeply colored lines, but not sulcate, 4–5 cm. across, pale light yellow when dry, margin paler, sublobate and uneven, narrowly incurved. Stem central, about 1 cm. long and 3–5 mm. thick, enlarged above into the pileus, solid, pale yellowish, under the lens finely velutinous. Pores unequal, decurrent, subquadrangular or elliptical, 1–2 mm. deep, margins acute and minutely erose-dentate. Spores allantoid, hyaline, 5–7 x 1μ. Color, pale yellow throughout.

A coarser, thicker plant than *F. curtisii* Berk., and lacks the ciliate margin and setulose stipe, nor can it be referable to *Polyporus alveolarius* Bosc.

Corticium ferax E. & E. On dead wood, Canada (Macoun). Thin, farinaceous, white, immarginate, soon developing in the central parts small patches of yellowish, smooth, waxy hymeium. Spores elliptical, hyaline, abundant, 4 x 3μ.

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[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

PENIOPHORA GLOBIFERA E. & E. On bark of *Abies*, Canada (Macoun). Effused, thin, soft when fresh, brittle when dry, cinereous, not cracking, closely adnate, margin at first fringed with appressed, silky, white hairs, which soon disappear. Cystidia at first globose, soon prolonged above into stout, rough, lanceolate processes, 40–70 x 8–10μ, hyaline. Spores small, globose, 3μ diam. The cystidia are very abundant and easily seen with a low power, causing the hymenium to appear pubescent.

ASTERELLA PROSOPIDIS E. & E. On living bark of *Prosopis dulcis* (Mesquite), near Monterey, Mexico, July, 1896. Dr. B. F. G. Egeling.

Perithecia gregarious or scattered, superficial, depressed-conical, ½ mm. diam., with a black, shining subconical ostiolum. Asci clavate-oblong, 30–35 x 8–10μ, subsessile, 8-spored, with stout linear paraphyses. Sporidia biseriate, fusoid, hyaline, uniseptate, not constricted, subacute, 12–14 x 4–4½μ.

CHAETOMIUM SETOSUM E. & E. On damaged hay in stacks, Rooks Co., Kansas, August 1896 (Bartholomew, No. 2214).

Perithecia at first ovate or ovate-conical, or cylindric-conical, becoming obovate and often flattened above, and contracted below so as to appear stipitate, 400–500μ high, clothed with straight, erect-spreading, smooth, black hairs, 150–200μ long and 5–6μ thick below, tapering above, not branched, with mycelium of reticulate, rough hyphæ and a fringe of brown, subundulate, short hairs around the base. Asci subelliptical, 10–12 x 6–7μ. Sporidia elliptical, brown, 4–5 x 3–4μ, and 2–2½μ thick.

Differs from *Ch. melioloides* C. & P. in the simple, smooth hairs that clothe the perithecia.

SORDARIA VIOLACEA E. & E. On horse dung, Rooks Co., Kansas, September 15, 1896 (Bartholomew, No. 2263).

Perithecia semiemergent, 2–4 confluent, 700–800μ diam., slightly depressed-globose, more or less roughened, with thick walls consisting of an outer dark-colored coriaceous sheet lined inside with a thinner, violet-colored membrane. Ostiolum hemispherical-papilliform or subdiscoid-depressed. Asci clavate-oblong, rounded at both ends, sessile. Paraphyses abundant, but indistinct. Sporidia 8 in an ascus, oblong-elliptical, becoming opaque, 30-45 x 19–21μ. The perithecia are mostly in confluent groups, but there is no true stroma.

SORDARIA AMPHISPHÆRIODES E. & E. On cow dung, Rooks Co., Kansas, August, 1896 (Bartholomew, No. 2249).

Perithecia scattered or 2–4 together, mostly about ¾ mm. diam., membranaceous, globose or slightly depressed-globose, entirely buried in the matrix which is not discolored within, the very short neck terminating in a depressed-globose, or subdiscoid ostiolum perforated in the center and erumpent through a black, superficial, stromatic shield, exactly as in *Clypeosphæria*. Generally the ostiolum is seated in a slight depression. Asci cylindrical, 220–230 x 20μ, very short stipitate, with cylindrical, continuous paraphyses longer than the asci and about 4μ thick. Sporidia uniseriate, elliptical or oblong-elliptical, yellowish, becoming opaque, 27–30 x 19–21μ, not appendiculate. Allied to *S. merdaria* (Fr.) and *S. macrospora* Awd., but distinguished from both by the stromatic shield.

Podospora minor E. & E. On old stalk of *Zea mays*, Rooks Co., Kansas, July, 1896 (Bartholomew, No. 2204).

Perithecia loosely gregarious, erumpent superficial, ovate-conical, 500 x 400μ, loosely clothed, except the black, obtuse, stout, short-cylindrical ostiolum, with spreading brown hairs. Asci cylindrical, 150 x 20μ. Sporidia obliquely uniseriate, ovate-elliptical or almond-shaped, 25–35 x 15–22μ, with a cylindrical, obtuse, brownish appendage 12–15 x 4μ at base, and sometimes with a much shorter, deciduous one at the apex. Differs from *P. brassicæ* Kl. in its smaller size throughout.

Rosellinia bigeloviæ E. & E. On dead stems of *Bigelovia graveolens*, Golden, Colo., December, 1896 (Bethel, No. 15).

Perithecia erumpent-superficial, scattered or gregarious and cespitose, ovate-globose, ¼–⅓ mm. diam., with a distinct, acutely papilliform ostiolum. Asci cylindrical, about 50 x 5μ. Paraphyses filiform, abundant. Sporidia uniseriate, oblong-elliptical, brown, 6–8 x 3½–4½μ.

Physalospora betulina E. & E. On birch bark, Newfoundland, September, 1896 (Rev. A. C. Waghorne, No. 62).

Perithecia subgregarious, sunk in the bark, but the apex raising the epidermis into pustules, ovate-globose, 400–550μ diam., light colored inside. Ostiolum inconspicuous. Asci clavate-cylindrical, 110 x 12μ, with abundant paraphyses. Sporidia uniseriate, elliptical or obovate, hyaline with one or two large nuclei, 18–22 x 10–12μ.

Leptosphæria phaseolorum E. & E. On old bean vines (*Phaseolus vulgaris*, cult., with *Diaporthe phaseolorum* C. & E., Newfield, N. J., July 27, 1896.

Perithecica scattered, ovate-globose, about ¼ mm. diam., covered by the epidermis, which is raised into slight pustules and pierced by the conical or conic-cylindrical ostiolum. Asci clavate-cylindrical, short-stipitate, paraphysate. Sporidia biseriate, oblong-fusoid, subobtuse, slightly curved or subinequilateral, 3–5 septate and constricted at the septa, hyaline, becoming brown, 16–22 x 5–6μ. Differs from *L. artemisiæ* Fckl. in its smaller size throughout.

PLEOSPORA FINDENS E. & E. On dead culms of *Andropogon virginicum*, Newfield, N. J., October, 1896.

Perithecia buried, globose, 150μ diam., with the conic-tuberculiform ostiolum erumpent. Asci cylindrical, short-stipitate, 130–150 x 12μ. Paraphyses none. Sporidia uniseriate, oblong, 5-septate, most of them with one or two cells divided by a longitudinal septum, straw-yellow. Many of the sporidia are without any longitudinal septa, resembling *Leptosphæria*. The pycnidial form is a *Hendersonia*, similar outwardly to the ascigerous, but with fusoid, straw-yellow, 3–4 septate sporules, 20–34 x 3–5μ.

PLEOSPORA OLIGOSTACHYÆ E. & E. On leaves of *Bouteloua oligostachya*, Rooks Co., Kansas, October 1896 (Bartholomew, No. 2325).

Perithecia scattered, hemispheric-prominent, small (200μ), black, with a minute papilliform ostiolum. Asci oblong-cylindrical, short stipitate, 65–75 x 12–14μ, with abundant paraphyses. Sporidia beseriate, oblong-elliptical, subinequilateral, 3-septate, scarcely constricted, one of the cells often divided by a longitudinal septum, but quite as often this is wanting, 14–17 x 6–7μ.

DIAPORTHE RADICINA E. & E. On bulbous base of culms of dead *Phleum pratense*, Newfield, N. J., December, 1896.

Perithecia in small groups buried in the matrix, which is blackened on the surface, about ¼ mm. diam. Ostiola erumpent, short-cylindrical, smooth, obtuse. Asci (p. sp.) cylindric-fusoid, 40–45 x 5–6μ. Sporidia 1–2 seriate, oblong, 3–4 nucleate, scarcely constricted, 10–12 x 3–4μ.

EUTYPELLA POPULI E. & E. On dead limbs of *Populus*, Canada (Macoun).

Stroma orbicular, convex, 1–2 mm. diam., seated on the wood and raising the bark into pustules, not circumscribed. Perithecia 12–30 in a stroma, closely packed, ovate-globose, about ¼ mm. diameter. Ostiola short cylindric-conical, erumpent in a dense, flat-topped fascicle, distinctly quadrisulcate. Asci (p. sp.) about 20 x 4μ. Sporidia subbiseriate, allantoid, only slightly curved, brownish in the mass, 4–5 x 1–1¼μ.

VALSARIA COLORADENSIS E. & E. On dead bark of *Negundo aceroides*, Overland, Colorado, November, 1896 (E. Bethel, No. 136).

Perithecia 4–6 or more, buried in a cortical stroma consisting of the whitened (but otherwise unchanged) substance of the bark, about ½ mm. diam., with thick coriaceous walls. Ostiola slightly erumpent through small chinks in the bark, subconfluent, conic-tuberculiform, black, mostly subseriately arranged. Asci clavate-cylindrical, 50–60 x 6–7μ, obscurely paraphysate, 8-spored. Sporidia subbiseriate, oblong-cylindrical, slightly curved, obtuse, brown, uniseptate, but not constricted, 12–15 x 3–3½μ.

The white substance of the stroma is surrounded by a thin, black layer, which, on a horizontal section, shows as a black line. Stroma orbicular or elongated, 2 mm.–1 cm. long.—J. B. ELLIS and B. M. EVERHARDT.

(*To be continued.*)

Botanical News.—The second century of Josephine E. Tilden's American Algæ has been distributed. It continues to maintain the high standard of excellence possessed by the first century. We should prefer to see the editor confine this distribution to the fresh-water algæ, since every marine form is but a duplicate of what one finds in so many other sets.

Professor L. H. Bailey's "Teacher's Leaflets," promise to be of great value, if we may judge from the one issued December 1st, entitled "How a Squash Plant Gets Out of the Seed." It consists of seven pages of text illustrated by fourteen *new* figures of every stage of the process. This leaflet should be in the hands of every High-School teacher of Botany.

We are glad to notice that the handy "Guide to the Organic Drugs of the United States Pharmacopæia," prepared by John S. Wright and published by Eli Lilly & Co., of Indianapolis, has reached its thirteenth thousand, and has been revised and greatly improved.

"Fodder and Forage Plants," by Jared G. Smith; "Useful and Ornamental Grasses," by F. Lamson Scribner, and "Studies on American Grasses," are repectively Bulletins 2, 3 and 4 of the Division of Agrostology in the United States Department of Agriculture. They have both a practical and scientific interest, and reflect credit upon the authors. In Bulletin 4 some generic changes are proposed, and a number of new species are described. The generic name *Chaetochloa* is proposed for *Setaria* (preoccupied), *Chamaeraphis* for *Ixophorus* (distinct genera). Accordingly the familiar *Setaria glauca* is hereafter to be *Chaetochloa* (L.) Scribn., *S. viridis* will be *C. viridis* (L.) Scribn., and *S. italica C. italica* (L.) Scribn.

The second bulletin of the New York Botanical Garden (issued January 1st) contains, in addition to Dr. Britton's vice-presidential address on Botanical Gardens (given before Section F of the American Association for the Advancement of Science), reports, plans, maps, regulations, etc. The map showing the general plan of the Garden is very interesting, and promises that when fully installed it will be one of the most instructive gardens in the Western Hemisphere.

In a recent number of *Garden and Forest* (January 13), Professor Card makes a strong plea for experimental plant physiology as an adjunct to instruction in modern horticulture. It will repay reading by all botanists, and should encourage the introduction of physiological work in agricultural colleges, where it has generally been neglected, as well as in the larger universities where it has already had some recognition.

Professor Hitchcock's bulletin (62) on Corn Smut, issued by the Kansas Experiment Station, gives, in addition to much relating to structure and the germination of the spores, an extended synonymy and bibliography. He concludes, rather hastily, we think, that the name under which this smut be known is *Ustilago mays zeae* (DC) Magnus (= *Uredo segetum* var. *mays zeae* DC., Fl. Fr., II, 1805, = *Uredo maydis* DC. Fl. Fr., VI, 1815). De Candolle himself did not consider that he had sufficiently designated it in Vol. II of "Flora Francaise," since, in Vol. VI, he does not refer to his note in the earlier volume, but proceeds to describe it as a distinct species under the name *Uredo maydis*. We should not now compel De Candolle to say in 1805 what, ten years later, he himself felt that he had not said.

Another little book has appeared from the facile pen of Professor L. H. Bailey, which is, incidentally, of considerable interest to botanists, although primarily designed for gardeners. Under the title, "The Forcing Book" (The Macmillan Company), he tells much about greenhouse construction, heating and management, which will be most useful to those botanists who possess, or hope to build, a plant-house. The chapters on Lettuce, Cauliflower, Radishes, Tomatoes, Cucumbers, etc., are admirable illustrations of clear presentations, and will be valuable to botanists as well as gardeners.—CHARLES E. BESSEY.

ZOOLOGY.

Paramœba eilhardii.[1]—The amæboid organism to which Dr. Fr. Schaundinn gives this new specific and generic name was found by him in the salt-water aquarium of the Berlin Zoological Institute. Its life history was found to consist of three stages. (1) An amœboid stage, in which the organism measures from 10–90μ microns, is disc-like, and is provided with blunt pseudopodia. In color it is often yellowish-brown, its plasma of a vacuolar honey-combed appearance, and its endoplasm with a large number of granules. Its central nucleus is vesicular and has an alveolar structure. Beside it is a peculiar refractive accessory body unlike anything found in other amœba. This, during the process of division, seems to divide before the nucleus.

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[1] S. B. K. Preuss. A. K , 1896, pp. 31–41 (12 figs.).

(2) An encysted stage, in which the vacuolar appearance disappears, the pseudopodia become retracted, and a cyst-membrane is formed. The sequence of division is (a) the accessory body, (b) the nucleus, (c) the plasma.

(3) A flagellate stage that begins by the emergence from the cyst of oval swarm spores, each possessing two flagella, an ingestive aperture, two chromatophores, a nucleus, and, like the first stage, an accessory body. Leaving out of account this last body the organisms very closely resemble species of *Cryptomonas*. Sometime after emerging from the cyst the spores divide longitudinally, lose their chromatophores, and become amœboid.

Diplodal Sponge-Chambers.[2]—Prof. F. E. Schultz after a re-examination of the matter, using as examples, *Corticium candelabrum* O. Sch., *Chondrilla nucula* O. Sch., and *Oscarella lobularis*, confirms his observations made on the flagellate chambers of the last form in 1877. The chambers have both an entrant and an exit aperture.

The Asymetry of Spirorbis and the Phylogenetic Relationships of the Species of the Genus.[3]—As a result of the examination of a large number of specimens of this genus derived from various parts of the world, and comprising a score of species, it has been found that these serpulids are entirely asymetrical. The form of the spiral is constant for a given species, and is either dextral or sinestral. In the dextral species the operculum is always borne by the second right branchial, while in the sinestral forms it is borne on the left second branchial—thus, in all cases, on the concave side of the animal.

The muscle-fibers are developed to the greatest extent on the concave side.

The intestine and ovaries are crowded to the convex side.

The uncini are most numerous and largest on the concave side.

In the abdominal region there are, speaking generally, n rows of uncini on the right and $n + p$ rows on the left side ($p. = 2–4$).

[2] Zool. Anz., XIX (1896), pp. 426–32.

[3] M. Caulberg and Félix Mesnil. Comptes-Rendus, CXXIV (1897), pp. 48–50.

There are met with in a series of species, dextral as well as sinistral, on the concave side, a third group of uncini, representing a fourth thoracic setigerous ring that is lacking in others.

All this shows the influence of the spiral tube, and is explained by the movements of the animal. The functional activity of the organs of the concave side has preserved them, and is to be taken into account in any phylogenetic grouping.

Taking the direction of the spiral and the presence or absence of the thoracic ring into account, it is evident that the genus *Spirobis* may be divided into four subgenera, as follows:

Dextral species,	
With 3 thoracic rings . .	*Dexiospira.*
With 4 thoracic rings . .	*Paradexiospira.*
Sinistral species,	
With 3 thoracic rings . .	*Læospira.*
With 4 thoracic rings . .	*Paralæospira.*

The Malpighian Tubes of the Orthoptera.[4]—The malpighian tubes of the Orthoptera, as regards their number and length, present a great analogy with those of the Hymenoptera, but differ from them in their disposition and their mode of opening.

Among the divers excretory contents of these glands have been found in abundance: urate of sodium and urate of calcium in *Gryllus;* uric acid in *Gryllotalpa,* in the form of irregular spherical or ovoid concretions or of prismatic crystals; urate of sodium and uric acid in *Blatta* and *Periplaneta.*

Mr. Bordas' studies embraced some forty species of the principal families of Orthoptera, and result in the following conclusions:

In the Forficulidæ the tubes are few (8–10) and grouped into two opposite fascicles.

In the Phasmidæ they are very numerous, and united into 20–24 fascicles (in *Phibalosoma*), opening into an equal number of hemispherical or conical tubercles, which are short and are disposed in a circle around the intestine, of which they are simply evaginations. In *Acanthoderus* and *Necroscia* each collecting tubercle receives only two or three Malpighian tubes.

In the Mantidæ there are some 60–70 urinal tubes, opening sometimes irregularly, sometimes in groups of three to four (*Eremiaphila*). The praying mantis possesses 50–60, united into several bundles, separated by narrow free spaces.

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[4] L. Bordas. Comptes-Rendus, CXXIV (1897), pp. 46–8.

In the *Periplanetæ* and *Blattæ* the tubes are grouped into six bundles, each with 15-20 tubes, opening at the summit of a very short conical tubercle. These six tubercles are simple evaginations of the intestinal wall, and are disposed in a circle about the intestine, at almost equal distances from one another. In *Polyzosteria* the tubes are filamentous, short, and likewise grouped into six bundles. In *Blabera* the mode of opening is characteristic, and very different from that in the rest of the Blattidæ. The tubes to the number of 50–60 are plain, embracing about a third of the intestinal circumference.

In the Acrididæ the number of tubes is very variable. Certain species (*Pœcilocerus* and *Pyrgomorpha*) have as many as a hundred, others (*Pamphagus*) have 60–70, others (*Œdopoda*) 70–80, others (*Psophus*, *Pachtylus*, etc.) 50–60. In all the tubes are grouped into a few bundles (5–6).

In the Locustidæ the number of tubes exceeds 100, grouped into six bundles, opening at the summit of 6 cylindro-conical tubercles, disposed sometimes regularly at equal distances from one another, sometimes irregularly, at the origin of the hind gut (*Locusta*, *Decticus*, *Salomona*, *Pseudorhynchus*, *Platicleis*, etc.). In the Ephippigerinæ one meets with three or four of these tubercles and some 110–120 urinary tubes. Finally, in *Gryllacris*, which in general have but a single, short collecting tubercle, there are some 80–100 Malpighian tubes.

In the Gryllidæ the number of tubes is great, and exceeds a hundred. In *Gryllus* and *Gryllotalpa* one finds 100–120. They open into a long unpaired cylindrical collecting tubule (ureter). This, after a course of 9 mm. to 12 mm., opens at the summit of a conical tubercle furnished with four valves limiting an asteriated orifice (*Gryllotalpa*).

Eels Feeding on the Eggs of Limulus.—In the latter part of May, four or five years ago, while walking at dusk along the Kickemuit River, which flows between the town of Warren and Bristol, R. I., I noticed many horse-feet crawling on the sandy bottom of the river. The tide was high, and they had come in from outside, as is their habit at high water. What attracted my attention the most was the fact that, as they lay there on the river bottom, many eels had worked their way into the clefts between their heads and abdominal regions, and were apparently feeding. Some of the eels were very large, and made a strange sight with their heads under the shell and their tails sticking out sideways. Sometimes two or three were under one horse-foot, and if I had had an eel spear I could have caught a good mess. I have since wondered what the eels were eating. Sometimes I think it might have been something on which the horse-feet were feeding; but my uncle, who was with me, said that they were after the spawn; and I have since come to the conclusion that he was right, for it was the spawning season, and the eels were only gathered around the large female horse-feet. This spring I intend to make further observations, and find out if this is really the case. Horse-feet are used a little as a food for poultry on some farms in Bristol, and it was in cutting some of them open that I noticed that the large ones were the females, for they were full of eggs.—H. C. WARWELL.

Elassoma *zonatum* East of the Apallachian Mountains.—In looking through the recently issued work by Drs. Jordan and Evermann, on the fishes of North and Middle America, I was reminded of having collected some years ago specimens of one of our smallest and least known fishes, in a locality that considerably extends its range as recorded by these authors. *Elassoma zonatum* is stated in the above mentioned work to occur from southern Illinois to Texas, Louisiana and Alabama. In 1882 the writer obtained specimens in Waccamaw River, near Whitesville, in southeastern North Carolina, and in the Little Pedee River in South Carolina. Evidently it was not at all rare where collected. My specimens were subsequently compared with material from southern Illinois in the collection of the Illinois State Laboratory of Natural History; and as Dr. Jordan had studied this collection in preparing his list of Illinois fishes, there can be no question about correctness of determination.

The number of scales in a longitudinal row along the side is not above 36, oftenest 34 or 35, and this is true also of Illinois specimens. The dorsal fin has 4 spines commonly, sometimes 5, and 10 soft rays, counting the posterior double ray as two. I believe that Dr. Jordan and his followers count this as a single ray, but its structure indicates that it is the equivalent of two ordinary rays. The anal fin has 3 spines and 6 soft rays, counting the double ray again as two. The branchiostegal rays are always 5 in number. In the description of the family Elassomidæ published by Drs. Jordan and Evermann the number of vertebræ is said to be 24 or 25, from which I judge the count was made from the Florida species, *E. evergladei*, which I have not seen, but in every specimen of *E. zonatum* examined by me the number is 29, including the mass which continues as the urostyle, of which 14 are precaudal. Illinois examples were not examined with reference to the vertebræ, but that they agree closely is shown by Dr. Jordan's own statement in the Bulletin of the Illinois State Laboratory (Vol. 1, No. 2,

p. 48, 1878), where the number is given as 28. My material was macerated and then examined with the microscope, and the count verified repeatedly on different specimens.

The colors of the Carolina fishes are the same as those of Illinois examples. The markings which at once catch the eye are a dusky bar below the eye and eleven narrow vertical bars on the side, two of those immediately behind the gill opening being enlarged to form a dusky spot. Three dusky dots at the bases of the caudal rays appear to be a constant character of young fishes.—H. GARMAN, Lexington, Ky.

The Human Tail.—According to Prof. W. Waldeyer,[5] who has recently gone over the subject, a tail is to be defined as a portion of the body that contains the caudal, *i. e.*, post-sacral, vertebræ and sundry other derivatives of caudal segments, all surrounded by integument. With reference to man, Virchow, in 1880, distinguished between tails with vertebræ and soft tails—a distinction generally recognized. As is well known the human embryo always shows evidence of a true vertebrated tail that may even persist after birth, yet in no case is it certain that more vertebral elements are present than are to be found in the normal coccyx. What occurs in tailed human subjects is the soft tail of Virchow, which corresponds to the distal non-vertebrated portion of the tail in other animals. In some cases this may be partly bony, but there is no increase in the number of caudal vertebræ.

ENTOMOLOGY.[1]

The Fauna of the Lower Rio Grande Valley.—Mr. H. F. Wickham publishes[2] an interesting paper on The Coleoptera of the Lower Rio Grande Valley, in which he discusses the faunal relations of the region as follows:

Regarding the true affinities of the Coleopterous fauna and the claim of the region to be considered tropical in its nature, opinions are more or less divided. Mr. Schwarz has stated that "no one can doubt the existence of a semi-tropical insect fauna along the north bank of the lower Rio Grande." Prof. Townsend classes the Brownsville fauna as Lower Sonoran, with a considerable touch of Austroriparian and about twenty-five per cent. tropical. Dr. Merriam has included it in his

[5] S. B. K. Preuss. Akad. Wiss., 1896, 775–84. J. R. M. S., 1896, p. 601.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Bull. Lab. Nat. Hist., Univ. Iowa, IV, 96–115.

tropical region. Dr. LeConte, writing thirty-seven years ago, speaks of it as a "sub-tropical province."

Looking through the list of species belonging to the five families treated in the present portion of this report, it seems to the writer that no one familiar with the Coleopterous fauna of the United States can pick out more than five or six which can be called characteristic of the Lower Sonoran zone, though it is true that quite a number range into it. A number—perhaps fifteen or sixteen—are tolerably characteristic of the Upper Sonoran, while possibly twelve or fourteen are more particularly tropical. The great majority are species of very wide distribution in eastern and central North America, many of them extending even to the Canadian boundary. No doubt can be entertained, however, that a study of the phytophagous families will yield a larger percentage of Sonoran and tropical species, since we may naturally infer that the carnivorous beetles, of which the present list is mainly composed, are less affected by peculiarities in the flora than the phytophaga.

More will be said on the subject in the concluding number of this article. For the present it will be sufficient to state the conviction that there is even less ground for considering the Brownsville beetle-faunas as Lower Sonoran than for classing it as tropical. The little jungles noted by Mr. Schwarz are to be considered, it seems, almost truly tropical, while, on the other hand, there are large areas of a very different nature surrounding these little forests, with a totally different Coleopterous contingent. Some of these areas are, from their elevated situation and dry climate, almost typically arid Lower Sonoran, while the low-lying damp spots, not tropical, will show a high percentage of forms common in humid regions occupied by what Dr. Merriam has called the Carolinian and Austroriparian faunas. In other words. Brownsville and its environs are not in one life zone, but in at least two, and probably three, the limits of these zones being locally irregular, and determined not by temperature conditions, but by those of soil and humidity, which, through their action on plant life, also influence the insects. The only way in which these conditions could be approximately indicated on a map, would be by spotting it with appropriate colors as in mapping Boreal or Arctic faunæ on isolated mountain peaks.

Life-history of Xylina.—In Bulletin 123 of the Cornell University Experiment Station, Mr. M. V. Slingerland discusses at length the life-history of three species of Xylina—*antennata, laticinerea, grotei* —which have done considerable damage by eating holes in young apples. "The green fruit worms," he writes, "do most of their damage to the young fruits in May, but some of them continue working until nearly the middle of June. During the first week in June most of the caterpillars get their full growth and then burrow into the soil beneath the trees to a depth of from an inch to three inches. Here they roll and twist their bodies about until a smooth earthen cell is formed. Most of them then spin about themselves a very thin silken cocoon ; some spin no cocoon. Within the cocoon or the earthen cell the caterpillar soon undergoes a wonderful transformation which results in what is known as the *pupa* of the insect. Most of these insects spend about three months of their life in the ground during the summer in this pupal stage. Some evidently hibernate as pupæ, and thus pass nine months or more of their life in this stage. Usually, about September 15th, the moths break their pupal shrouds and work their way to the surface of the soil. Most of them emerge in the fall before October 15th, and pass the winter as moths in sheltered nooks ; some evidently do not emerge until spring. Warm spells in winter sometimes arouses a few of them from their hibernation.

"During the first warm days of early spring all the moths appear, and doubtless the mothers soon begin laying eggs. No observations have been made on the eggs or young caterpillars in the north, but in a newspaper article published in the south in 1872, it is stated that the eggs are deposited in the spring on the undersides of the leaves. They hatch in a few days, and the young worms begin at once to eat the foliage, or the fruit, or both.

"There is thus but one brood of these green fruit worms in a year. They work mostly in May, pupate in the soil in June, live as pupæ during the summer and sometimes all winter, and most of the moths emerge in the fall and hibernate, laying their eggs in the spring."

Notes on Dragon-flies.—Prof. D. S. Kellicott publishes[3] some interesting data regarding the occurrence of Odonata in Ohio during 1895 and 1896. "In 1895," he writes, "I prepared and published a chart showing what was then known about the distribution and time of flight of each of the eighty-six species of Odonata known to inhabit Ohio. It was believed the record, so far as it went, was reliable. Some species had been found only in limited areas and at definite times in the year. The schedule showed what species occurred in early, mid and late summer, and in northern, central or southern Ohio. But with the opening and progress of the present season, my confidence in the chart referred to has been severely tested. How did it happen? We naturally turn to the climate and its vicissitudes for the explanation of many things—trivial and grave. Will it help us in the matter in hand?

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[3] The Agricultural Student, III, 141.

"The seasons of 1894 and 1895 were very dry throughout the State. Streams and ponds lost all their water and the mud at the bottom was dry and parched for months over large areas. Streams of considerable volume in ordinary years disappeared entirely for weeks or there remained only restricted pools here and there. The winter of 1895–6 was constant for Ohio with less than the average snowfall. The weather remained cold until April 10th, when it suddenly became very warm and remained so with abundant rain. What resulted as to the appearance or non-appearance of dragon-flies? The following notes will state some of the observed facts:—

First—Many species occurred unusually early. The largest number recorded in April at Columbus in any previous year was five; this year it was ten. They were taken in the following order: *Anax junius*, April 13th; *Ischnura verticolis*, April 15th; *Didymops transversa*, *Basiaeschna janata*, *Anomolagrion hastatum*, *Lestes forcipata*, *Tramea carolina*, *Plathemis trimaculata*, *Libellula semifasciata* and *Nehalennia posita*. The variety is not less interesting than the number. Among them are some of our largest species and the smallest; while four families are represented. Five have been taken in April in previous years, although not in the same year. Anax, Ischnura, Didymops, Basiaeschna and Tramea have been taken as early in former years, the first two much earlier, but the remaining forms not until May was well advanced or until midsummer. From this a general statement may be made that five of the ten earliest species appeared no earlier than usual, but appeared suddenly, i. e., after a very few warm days, while five appeared from two to four weeks early than ever before noticed. I may extend this record of early occurrence by saying that thirty-five species were taken before the end of May, and that several of them were those not before seen on the wing until midsummer.

"In this connection let me say that species common to Ohio and the Atlantic coast appear to emerge fully two weeks earlier in the interior than on the coast at the same latitude. Nor is it a matter of isotherms alone, as a glance at an isothermal map and the recorded captures at Philadelphia and New York will show. It is, I suspect, due rather to distribution of heat and affects only early appearing species.

"Second—It is an interesting question, one often asked, but not answered, whether the existing species are fewer than when the country was more primitive. The diminution of streams, ponds and morasses, as well as the pollution of streams, have been taken to be sufficient causes for their reduction. The unusual conditions for 1894 and '95 naturally lead us to inquire if any light has been shed on the question. What, then, have been the observed results? So far as my observations have gone, and I have been much in the field, there is no evidence in the line expected. Odonata in the region included in these notes have been unusually abundant during the summer of 1896. No species hitherto taken in any abundance has been missed, while several not before taken at all have been abundant. This was unlooked for. Possibly my records indicate this, that the usual abundance in early spring and summer was in the vicinity of perennial waters, and that about the transient ones they were fewer than the normal number; it is certain that all of the six or seven additional species taken were found in the vicinity of such streams and ponds.

"The consideration of the foregoing facts and the conditions which seem to have influenced them leads to a possible clue to the causes. Life of all kinds, plant and animal, in the restricted and concentrated waters of the dry seasons, were excessively abundant. The predacious odonate larvae, so long as any moisture remained, would be in clover; but when the water entirely disappeared, what?

"Unfortunately, there are no records at hand in regard to ability to remain in the mud or within capsules of earth at the bottom of dried-up ponds. Other animals and some large larvae are known to do so. Why not also the larvae of Odonata? If this fact was proven it would easily explain the unusual abundance of dragon-flies this present season in place of an anticipated dearth. Again, the eggs of some species, certain species of Diplax for example, do not hatch immediately, and therefore, may remain in the dust or mud until the autumn rains or until spring. In this connection I may state that *Diplax rubicundula* and *D. obtrusa* have been seen industriously ovipositing among the grass and weeds overgrowing dry ponds and ditches. Eggs thus scattered would certainly have to remain without immersion among dust and rubbish, in some instances, for weeks. The female of *Lestes rectangularis* has been seen ovipositing in stems of Scirpus and Sparganium where no water remained in the marsh and surely did not return for a month. It would appear from these incomplete observations that the nymphs of Odonata may and probably do readily pass the trying times of drouth unharmed.

"Third—Records made this summer have confirmed conclusions of former years that southern forms extend their range on the western border of Ohio to Lake Erie. I may cite, as example, *Dromogomphus spoliatus*, which, until taken by me at Toledo, was recorded only from the extreme south. I do not remember to have seen it in any private or public collections. This year, along the Maumee River, it was exceedingly abundant."

Changes of Intestinal Epithelium in Tenebrio.—Herr C. Rengel has studied the changes of the intestinal epithelium in the metamorphosis of the Mealworm (*Tenebrio molitor*) and compared them with those occurring elsewhere. Regenerative cells, from which the new epithelium is derived, appear as subepithelial islands in very young larvæ, but it is only when the metamorphosis begins that they give rise to the elements which form the invaginal epithelium. As in Muscidæ the disruptions begin with an energetic contraction of the muscular layer, and the old mid-gut epithelium is raised off. Its disintegrating cells are held together in a "cyst" by their membranea propria, and form the "yellow body." The muscles undergo gradual disruption without active invasion by phagocytes as occurs in Muscidæ. Korotneff compared the two modes to chronic and acute pathological processes. As soon as the larval muscular layer had been disrupted, nuclei are seen surrounding the epithelial cylinder. Whether these nuclei are old or new elements is doubtful, but the small cells of which they form the centers become the fibrils. Rengel's opinion is that many muscle-cells survive the general revolution, just as a large number of epithelial regeneration cells persist. The latter give origin to the epithelial cylinder, the former to the muscular layer. (Journ. Royal Micros. Soc.)

PSYCHOLOGY.[1]

Dreams.—At the Psychological Congress last year, Dr. J. Mourly Vold, of Christiania, reported some experiments which he had undertaken with regard to the artificial stimulation of visual elements in dreams. The subjects included a large number of persons of different ages, sexes and classes, but were mostly adults of an intellectual type above the average; all those selected were good dreamers. Dr. Vold arranged the experiments as follows: To each of his subjects he sent, from time to time, a package containing figures of animals, well-known objects, etc., cut out of white paper, or some striking colored object—

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[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.

a flower, coin, etc. The package was only opened after the subject was in bed. The contents were then displayed on a black background, and scrutinized closely for a considerable time—usually from two to ten minutes—without intermission; in some cases for half an hour or more, interspersed with periods of rest. The light was then put out, and the eyes closed. In the morning, immediately on awaking, the subject wrote a report of his dreams, together with the conditions of fatigue the night before, length of sleep, etc. Prof. Vold supplemented these reports, when it seemed desirable, by verbal questionings. Some 300 separate tests of this nature were made.

On examining the results, it was found that the character of the dreams depended on a number of distinct factors, such as the quietness and uneventfulness of the preceding evening, but that it did not depend (so far as could be discovered) on the specific time of experimentation or of awakening, nor on the obtaining of after-images from the given objects. The size, form and color of the objects were rarely all reproduced together, but one or two of these conditions often reappeared in the dreams. The form and size of the object were frequently reproduced, either as in the original or with some modification; this transformation often occurred in the dream itself. The color exerted an influence independent of the other factors, and this proved the point of greatest interest in the results. When the given objects were black or white (with complimentary background) the dreams in many instances exhibited recurring contrasts of light and shade. Often the object reappeared (with considerable change of form) in the same color as shown; or some other object appeared in the given color, which might be a very unusual one for it to take; in this case, either the color of the background reappeared also, or no background was discerned. In experiments with colors other than black and white, the given color also tended to reappear; this was especially the case with red; the color might recur in the same tone, saturation and brightness as in the given object, or it might appear modified in these respects; or, such a modification might take place in the course of the dream, as in the case of modifications of form.

The author concludes from these experiments that the visual apparatus immediately before awakening reproduces to a certain extent the condition present at the time of falling asleep; but that the original associations of form, size, color and abstract representation are broken up, and new syntheses constructed in their stead. In these new syntheses the common visual forms, or abstract representations of daily life, are apt to become associated with the colors or outlines of objects which affect the organ of vision just before the beginning of sleep. Some such theory seems necessary to account for the facts brought out in these experiments.

In a note in the *Revue philosophique,* M. E. Goblot speaks of the connection between dreams and the act of awakening. He urges the view that dreams which we remember are those which accompany the latter state. The passage from sleep to wakefulness, like that from wakefulness to sleep, is not an instantaneous process; it occupies at least an appreciable time. The dreams which we are able to remember afterwards are those that belong to this period of transition; and this fact, the author insists, is more than a mere coincidence. When we analyze a remembered dream, we find in its last stages always some elements of external sensation, which gradually (or quickly) unfold into the conditions of normal waking life. All the organs of sense and movement do not wake at the same time; and to this is due the transition period just mentioned. It is only the dreams of this period—in which some of the conscious elements are those of sleep, while others belong to waking life—that we are able to connect through memory with after-consciousness; and the memory connection is due to precisely this association of elements of waking consciousness with the dream elements. This is the reason, says M. Goblot, why we do not remember those dreams occurring early in the night, in which we talk, cry out, gesticulate, or walk, though such dreams can scarcely fail to have been most vivid; for, unless they result in our awakening, there is no associative element in waking consciousness capable of recalling them. Even those dreams which we do recall have usually so slender an associative element that they are speedily forgotten, unless we take special pains to impress them upon the memory by writing them down, or rehearsing them soon after waking.

The present writer would suggest that more attention be paid, in the study of dreams, to determining the normal visualizing power of the individual. It is well known that some persons habitually "visualize" their visual memories (*i. e.*, represent them in the form and color of the original); while others, including those more accustomed to abstract thinking, are lacking in this power, and substitute words or other symbolism for the visual picture. The same is true to some extent of sounds and other classes of sense memories. In sleep, where outer stimulation is practically wanting, central images play the chief rôle, and in the absence from consciousness of more vivid presentations are mistaken by the subject for primary sense impressions. It would seem, then, that there ought to be a broad distinction of some sort between the dreams of the visualizing and symbolizing types of individuals. Whether good visualizers are better dreamers, or whether their dreams are merely of a different character from those of symbolizers, remains to be seen. But certainly the question is well worth investigating. So far as I know, no attempt has yet been made to gather data bearing on this point. —H. C. W.

Courtship of Grasshoppers.[1]—Prof. E. B. Poulton has observed this process in two different genera of Acridiidæ. In the case of *Pezotettix pedestris* the sombre brown male quietly awaits, without audible stridulation, the appearance of a female, and jumps upon her unawares. At first she tries to escape, but after a little struggle submits. Before pairing the male nibbles the female gently, and while holding her keeps moving his short legs up and down. This latter process Prof. Poulton regards as a vestige of true stridulation, and that it may still be of use in influencing the female in some way.

In the case of *Gomphocerus sibiricus* the process is much more ceremonious, the males stretching out their four palpi, stridulating, and even patting the female. Apparently the habits are influenced by temperature, for certain phases of courtship could be studied most satisfactorily when the insects were first aroused to activity.—F. C. K.

ANTHROPOLOGY.[2]

Recent Pile Structures made by Seminole Indians in East Florida.—Mr. Henry G. Bryant, Secretary of the Geographical Society of Philadelphia, informs me that he saw, in the latter part of March, 1896, several pile-built structures made by modern Seminole Indians rising above the water of a salt estuary of the New River in Dade Co., Florida. He, in company with Dr. Murray Jordan, had visited the Seminole settlement called Big City, situated on the eastern side of the Everglades, within reach of the tide-water of New River, and above the site of old Fort Lauderdale, a region now made accessible by railroad from Lake Worth to Miami.

Ascending the river in a small steamboat for some eight or ten miles above Fort Lauderdale, Mr. Bryant, with a local guide, had proceeded in a flat-bottomed boat over a submerged meadow-like country to Big City, which he found to consist of six or eight rectangular huts with the typical palm-thatched roof of the country. Though these habitations were built on higher ground which overlooked a lake-like expanse of water, two or three platform structures were built directly over the water, at a distance of fifteen or twenty feet from the shore. The platforms, about ten feet long by three and a half wide, without roof, rail, mat or cover, and about three feet above the surface of the water, were upheld by four poles driven into the bottom of the estuary. On inquiry Mr. Bryant who observed no objects resting upon them, learned that the platforms served the Indians as beds when, on warm summer nights, an exposed position over the water guaranteed coolness and immunity from mosquitoes.

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[1] Trans. Ent. Soc. Lond., 1896. J. R. M. S., p. 516.

[2] This department is edited by H. C. Mercer, University of Pennsylvania.

Just around the end of the peninsula from the Ten Thousand Islands, not, therefore, above ninety miles east of the site of numerous ancient pile-built structures recently unearthed among these Keys by the University of Pennsylvania, the modern pile-set platforms of Big City seemed to furnish an interesting connecting link between the present and the past of Florida. It is hard to see how riparian savages, dwelling in any low-lying, submerged region, could avoid setting structures on piles. The town of Borneo (Lubbocks Prehistoric Times, p. 184), is built on piles like many Dayak villages. So is Sowik in New Guinea. The Turkish fishermen live in pile-set huts on Lake Prasias (near Salonica), just as a pile-built quarter of Tcherkask rests upon the Don, while the natives of Celebes, Solo, Aram, Mindanao, the Caroline Islands and the African gold coast continue the building of dwellings on piles at the present day.

The desire to escape mosquitoes has not been generally quoted as the motive for aboriginal " lacustrine " construction, but I myself have experienced the efficacy of a water surrounding as an immunity against mosquitoes, when house-boating along the mosquito-infested shores and islands of the Lower Rhone. Then I invariably escaped the pests that often swarmed a few yards away by anchoring for the night twenty or thirty feet out from the shore. As at Big City, the desire to escape mosquitoes seems to have inspired the pile builder, so in British Columbia, Lord says, (see Stephens' Flint Chips, p. 123) that Indians on the Suman prairie recently built pile dwellings on a lake in April and June to avoid mosquitoes. Venezuela came by its name (Little Venice) because of numerous aboriginal pile dwellings seen by Alonso de Ojeda in a bay called by him the Gulf of Venice in 1499, while the shores of its interior lake, Maracaibo, present native pile-dwellings inhabited to-day. Considering these facts, it may be suspected that the littoral regions of North and South America will, when thoroughly examined, more generally reveal this method of Aboriginal construction, not as evidence of a unique type of culture, a "lost race," or a phase of human development, but as a common adaptation of the life of savage peoples, ancient and modern, to their daily environment. To what extent the hybrid Seminoles of Creek origin and post Spanish advent had intermingled with remnants of older tribes (presumably the builders of the Ten Thousand Islands villages) encountered by the first Spanirds in Florida, is unknown, but I heard no mention of pile construction as practiced by modern Seminoles at the meeting of the American Philosophical Society when the recently excavated-pile structures of the neighboring Ten Thousand Islands were discussed.

—H. C. Mercer.

The Grooved Stone Axe in South America.—The idea of the Ethnic unity of American Indians is strengthened by the fact that so common an implement of their stone age as the axe should have been hafted among them in a peculiar fashion (namely, by means of a groove), unknown, it seems, in all other parts of the world except Australia. Continuing to find these grooved stone axes throughout South America adds strength to this interesting contrast between the ancient handicraft of the new and old world, though it appears that the wide distribution of the grooved axe south of Panama has not been often noted. The Columbian Exhibition at Madrid, in 1892, showed a grooved axe (in the Pedro Baranda collection) from Campeche and a number of others from Ecuador, which could not have been distinguished from Delaware Valley specimens. One came from Nicarauga, another from Peru, and several from Bolivia, together with a curious specimen, the base of the groove of which was marked with spiral flutings. Several such axes had been collected among the Tarasco Indians in Mexico, and other typical familiar-looking specimens came from Uruguay with neighbors from the Argentine Republic. Not a few of the axe-like forms from Uruguay, Equador, Nicaragua and the United States of Columbia had round (pounding) or pointed (piercing) rather than blade-like (cutting) ends, and round stones, encircled by grooves of the Sioux hammer pattern, were sometimes noticed, as, for instance, in Equador and Uruguay. That similar mallets (though never axes) hafted on the grooves were common in prehistoric Spain, was shown by a number of ancient Iberian specimens photographed by me at the Museo National, Madrid. Mortillet figures them from Italy, and the Swedish Government exhibited examples at the Columbian Exhibition above-named from the east Siberian coast of Behring Straits. Notwithstanding a few flat celt-like specimens from Peru, perforated as if for hafting, binding the handles on grooves, seemed to be the universal American characteristic, as against which omnipresent fashion in the new world, we know that the Neolithic peoples in Europe hafted all their stone axes through holes perforating the axe. Why the latter method (granted migration during or after Neolithic times) never reached America remains to be explained.—H. C. MERCER.

MICROSCOPY.

A Method of Preparing Rotifers.[1]—According to N. de Zograf rotifers may be fixed and mounted in glycerin, balsam or dammar and still retain the appearance of life by a slight modification of the method attributed to M. Rousselet in Hennegrey's and Lee's "Traité de microscopie technique."

The animals in a watch glass are narcotized with a solution of cocaine, as used by Rousselet, except that the methylic alcohol is omitted. The solution is added drop by drop to the very small amount of water containing the rotifers. As soon as the movements of the animals cease without having contracted their cilliary apparatus, a considerable quantity of a 1 per cent. solution of osmic acid, diluted with 4–5 volumes of water, is turned upon them and allowed to act for about 2–4 minutes.

Meanwhile a large amount of the liquid is removed with a pipette without disturbing the animals, which have settled to the bottom of the glass. Finally, a weak solution (about 1 volume to 8–10 of distilled water) of crude pyroligneus acid is poured over the animals, and permitted to act for from 5–10 minutes, after which the animals are washed two or three times with distilled water and then the water containing them very gradually replaced by alcohol, commencing with 50 per cent. and finishing with absolute alcohol.

Thus prepared the animals are found to have contracted neither their abdominal appendages, their feet, their band of cillia, nor their tentacles, and can be mounted equally well in glycerin, balsam or dammar. The protoplasm as a result of the action of the osmic acid has a faint gray or brownish tint; and structural details are plainly visible.

The Scirtopods (*Pedalion mirum*) and the Rhizotes (*Melicerta, Lacinularia, Floscularia, Stephanoceros*) give the most beautiful results, and sometimes, if the action of the reagents has been only sufficient to fix the animals, they appear in Canada balsam like living animals.

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[1] Nicolas de Zograf. Sur une méthode de préparation des Rotateurs. Comp. Rend. Acad., Paris, CXXIV, 245–6.

The same method, the author says, has given him perfect results with many infusorians, heliozoans and rhizopods, as well as with *Hydra* and other fresh water forms. With these animals, however, the narcotization is not necessary, but the osmic acid should be increased.—F. C. Kenyon.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—February 17, 1897.—The following papers were announced: Prof. N. S. Shaler, "Subterranean Water of Southeastern New England;" Dr. C. R. Eastman, "On some Devonian Fish-beds of North America.

March 3.—The following papers were announced: Mr. T. A. Jagger, Jr., "Experimental Study of Mountain Building" (illustrated by models); Mr. J. B. Woodworth, "Geology of the Gay Head Cliff."

March 17.—The following paper was read: Mr. Frank Russell, "An Account of a Naturalist's Voyage down the Mackenzie."—Samuel Henshaw, *Secretary.*

American Philosophical Society.—January 1, 1897.—Mr. Henry C. Mercer read a paper on "The Fossil Sloth of the Big Bone Cave, Tennessee."

February 19.—Prof. E. D. Cope presented a communication on "Some Paleozoic Vertebrates from the Middle States."

March 5.—Prof. Arthur W. Goodspeed exhibited some Recent Radiographs in comparison with the work of a year ago.

University of Pennsylvania.—February 15, 1897.—Program Demonstrations: "Some Types of Insects Injurious to Vegetation," Dr. S. C. Schmucker. Original Communications: "Hatching of Dragonfly Eggs," Dr. Philip P. Calvert; "The Morphology of the Nucleolus," Dr. T. H. Montgomery. Reviews: Drs. Macfarlane and Harshberger.

March 1st.—Program Demonstrations: "The Method of Measuring the Time of Mental Processes," Dr. Lightner Witmer. Original Communications: "Reaction Time of Americans, Indians and Negroes," Mr. Albert L. Lewis. Reviews: "Vertebrate Paleontology," Dr. E. D. Cope; "Physiological Chemistry," Dr. M. E. Pennington; "Botany," Dr. H. C. Porter.—H. C. Porter, *Secretary.*

The Biological Society of Washington.—January 30, 1897.—The following communications were made: "Brief Informal Notes and Exhibition of Specimens;" C. Hart Merriam "On the Pribilof Island Hair Seal;" C. H. Townsend, "The Origin of the Alaskan Live Mammoth Story;" L. O. Howard, "Parasites of Shade-tree Insects in Washington;" Frank Benton, "The Giant Bee of India."

February 27.—The following communications were announced: "Brief Informal Notes and Exhibition of Specimens;" C. H. Townsend, "The Distribution and Migration of the Northern Fur Seal;" Lester F. Ward, "Description of Seven Species of Cycadoidea from the Iron Ore Deposits of Maryland;" Charles Louis Pollard, "What Constitutes a Type in Botany."

March 13.—The following communications were made: W. T. Vaughan and R. T. Hill, "The Lower Cretaceous Gryphæas of the Texas Region;" Chas. F. Dawson, "The Dissemination of Infectious Diseases by Insects;" William Palmer, "The Type (?) of a New-old Species;" Sylvester D. Judd, "Sexual Dimorphism in Crustacea."—FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—February 27, 1897.—The following program was presented: 1. "The Language Used in Talking to Domestic Animals," Dr. H. Carrington Bolton; 2. "Prehistoric Musical Instruments," Mr. Thomas Wilson.—WESTON FLINT, *Secretary.*

The Academy of Science of St. Louis.—January 18, 1897.—Professor H. S. Pritchett presented some results of observations on the recent sun-spots, prefacing his remarks by a general account of our present knowledge of the constitution of the surface of the sun, and of sun-spots in general, and illustrating his remarks by the use of lantern slides.

Two persons were elected to active membership.

February 1, 1897.—Professor L. H. Pammel read a paper embodying Ecological Notes on Some Colorado Plants, observing that botanists who have studied the Rocky Mountain flora have frequently commented on the interest attached to the plants from an ecological standpoint, but most perplexing to the systematist. It is not stange that this should be the case, since there are great differences in altitude and soil, and the relative humidity of the air varies greatly. This is a most prominent factor in the development of plant life. A cursory glance at the plains flora of eastern Colorado shows that there are representatives of a flora common from Texas to British America, and east to Indiana. We should not for a moment suppose that the species are identical in structure, since the conditions under which they occur are so different. Attention was called to the great abundance of plants disseminated by the wind, as *Cycloloma, Salsola, Solanum rostratum, Populus, Cercocarpus,* "Fire-weeds," (*Epilobium spicatum* and *Arnica cordifolia*), *Hordeum jubatum, Elymus sitanion,* etc. Plant migration may be studied to better advantage in the irrigated districts of the west than elsewhere, partly because the water carries many seeds and fruits in a mechanical way, and partly because the soil is very favorable for the development of plants. Instances were cited where several foreign weeds are becoming abundant, as *Tragapogon porrifolius* and *Lactuca scariola.* The latter, known as an introduced plant for more than a quarter of a century, is common at an altitude of 7,500 feet in Clear Creek Cañon. Once having become acclimated it is easy to see how Prickly Lettuce is widely disseminated.

Collectors appreciate the great importance of giving more attention to conditions under which plants thrive, such as phases of development, soil, climate, and altitudinal distribution. Structures of plants are produced to meet certain conditions. Under extreme conditions, protective devices are more pronounced. In discussing some of the plants, Warming's classification into *Hydrophytes, Xerophytes, Halophytes,* and *Mesophytes*, was adopted. The *Mesophytes* of eastern Iowa were compared with some of the *Xerophytes* of western Iowa, such as *Yucca angustifolia, Mentzelia ornata, Liatris punctata,* etc. These increase in abundance in western Nebraska, and attain a maximum development in northern Colorado. In the foot-hills and mountains the *Metophytes* constitute a large class, although *Xerophytes* are common in dry, open, sunny places. The photosynthetic system is reduced to guard against excessive transpiration, which would otherwise take place at high altitudes. The thick rootstock of Alpine plants in dry, open places is an admirable protection against drouth and cold. In cañons where snow remains on the ground plants do not need this protection. *Halophytes* are not numerous in species and genera. *Hydrophytes* are abundant at higher altitudes, where they occur in marshes and along streams.

February 15, 1897.—Professor J. H. Kinealy presented a preliminary discussion of the Poley air lift pump, a device for pumping water from artesian wells by injecting into the pump tube, at a considerable depth below the surface of the water, bubbles of air from an air compressor.

Mr. Trealease exhibited two hair balls removed from the stomach of a bull in Mexico, and showed that they were composed of the pointed barbed hairs of some species of prickly pear upon which the animal had unquestionably fed. Attention was called to similar balls from the stomachs of horses, which had been described in 1896 by Mr. Coville, of the United States Department of Agriculture.

March 1, 1897.—Mr. William H. Rush presented a demonstration of the formation of carbon dioxide and alcohol as a result of the intramolecular respiration of seeds and other vegetable structures in an atmosphere containing no free oxygen. The theory of the dissolution and reconstruction of the living nitrogenous molecules was explained in connection with the experiments, and the different behavior of these molecules when supplied with or deprived of free oxygen was indicated.

Mr. H. von Schrenk briefly described certain œdematous enlargements which he had observed at the beginning of the present winter, near the root tips of specimens of *Salix nigra*, growing along the edge of a body of water. The speaker compared these with the œdemata of tomato leaves and apple twigs, which were studied some years since at Cornell University.

Professor J. H. Kinealy exhibited a glass model illustrating the mode of action of the Poley air-lift pump, the efficiency of which he had discussed at the preceding meeting.

One name was proposed for active membership.—WILLIAM TRELEASE, *Recording Secretary.*

Torrey Botanical Club.—January 27, 1897.—The scientific program was as follows: Dr. H. H. Rusby, "Remarks on some Solanaceæ;" Mr. A. A. Tyler, "The Origin and Functions of Stipules;" Dr. J. K. Small, "*Aster gracilis* Nuttall;" Mr. George V. Nash, "New and Noteworthy American Grasses."

Dr. Rusby exhibited a number of solanaceous plants and remarked upon their relationships. It was pointed out that the general appearance and chemical and physiological characteristics of these plants frequently fail to indicate their structural affinities. *Cestrum* and *Sessea*, *Atropa* and *Datura*, were cited as illustrations of the separation of otherwise naturally related groups through their possession respectively of baccate and capsular fruits. *Nicotiana* was referred to as connecting those tribes having a radial symmetry with the tribe Salpiglossidæ, having a bilateral symmetry, and thus connecting the family with the Labiales. The Androcera and Andropeda sections of the genus *Solanum* were instances of the appearance of this bilateral symmetry in a widely separated part of the family, where radial symmetry is the otherwise invariable rule.

Dr. Britton discussed the subject, and remarked upon this instance of development of two divisions of a group along different lines, in this case through baccate and capsular fruits. He cited similar parallelisms in other families, tending to produce different resulting characters—as in *Capparidaceæ;* and remarked that an indication of the lines along which these genera have been derived may be read in these characters.

The second paper by Mr. A. A. Tyler, on "The Nature and Origin of Stipules," presented conclusions derived from studies extending through several years. The subject was treated at length in the light of geological, morphological, anatomical and developmental evidence. Discussing Mr. Tyler's paper, which will shortly be published in full, Dr. Britton remarked that "the outcome of this very important paper is most interesting; it emphasizes the significance of basal scales and those of buds and root stocks; and it is the more convincing, from the nicety with which it accords with the seemingly haphazard distribution of Stipules widely but irregularly here and there through the vegetable kingdom."

Mrs. Britton discussed the paper further, referring to the different phases presented in *Fissidens.*

Of the remaining papers, that by Mr. Nash was read by title, and will appear in the *Bulletin;* and that by Dr. Small was, on account of the lateness of the hour, deferred till the next meeting.—EDWARD S. BURGESS, *Secretary.*

SCIENTIFIC NEWS.

The New Westminster *Daily Columbian* (B. C.) informs us of the death of MRS. ALICE BODINGTON, wife of Dr. G. F. Bodington, Medical Superintendent of the Provincial Asylum for the Insane. Even the comparatively few who were aware of Mrs. Bodington's illness, from pneumonia, had no idea of there being any immediate danger. In fact, her illness was very brief, scarcely five days, and no dangerous symptoms were developed until Sunday. All that loving care and medical skill could do was unavailing, and, on Monday, February 15th, death released a noble soul from its bodily sufferings.

The deceased lady, who was a native of Suffolk, England, came to the Province, with her husband, about ten years ago, and, after a short residence in Vancouver, they removed to Hatzic, where the doctor engaged in farming, in connection with a country practice. About two years ago, on receiving his appointment to the asylum, Dr. Bodington removed to New Westminster with his family.

In the comparatively short time since, Mrs. Bodington made many friends in New Westminster, and helped on many a good cause. Besides being an energetic worker in Church of England circles, she was instrumental in forming a local branch of the Botanical Society of Canada, and was a warm friend of the Public Library and of the Art and Scientific Society, before which she read able papers on more than one occasion.

For many years Mrs. Bodington had been well-known in the world of letters. Widely read and a profound thinker, she wielded a strong pen, which was always ready to defend those principles of which she was so able an advocate. Among other works, Mrs. Bodington was the author of "Studies in Evolution and Biology." She was also a regular contributor to THE AMERICAN NATURALIST, *The Popular Science Review* and the *International Journal of Microscopy.* Mrs. Bodington also frequently contributed vigorous articles on various subjects to the Provincial and local press.

Socially, the deceased lady will also be greatly missed, while, as wife and mother, her death is a sad bereavment, and Dr. Bodington and his family have the kindliest sympathy of the community in their irreparable loss. Of the many children of Dr. and Mrs. Bodington, but two, Miss Winnie Bodington and a young son, are at home. Of the others, all grown up, one son is at Plymouth, another also being in England, one is a barrister in Paris, France, another physician on one of the Empress liners, and two daughters, Miss Bodington and Mrs. Hamilton, reside in Winnipeg.

The Goode Memorial Meeting.—On the evening of February 13th, the various scientific, patriotic and historical societies of Washington met in joint session at the U. S. National Museum to commemorate the life and services of the late Dr. George Brown Goode. The meeting was held under the auspices of the joint commission of the scientific societies of the city. After a few introductory remarks by the president of the commission, Hon. Gardiner Hubbard, there followed a brief address from Dr. S. P. Langley, who spoke of Dr. Goode in his relations as a friend and official of the Smithsonian Institution ; from Postmaster-General W. L. Wilson, who spoke of him as a citizen and historian ; from Professor H. F. Osborne, who spoke of him as a naturalist ; and from Professor W. H. Dall, who eulogized him in his relations to the advancement in general of American science. Finally, a set of eulogistic resolutions were offered by Hon. O. B. Wilcox, President of the society of the Sons of the American Revolution, which were adopted.

Dr. S. L. Schenk has been advanced to the position of ordinary professor of embryology in the University of Vienna. Dr. J. Blaas has had a similar advancement to the chair of geology and paleontology in the University of Innsbruck, and S. Bianchi to the chair of anatomy in the University of Siena.

Dr. K. Möbius has been appointed director of the Museum in Berlin, in the place of Dr. H. E. Beyrich, deceased. Prof. W. Dames has been placed in charge of the geological and paleontological collections.

Dr. Th. D. Pleske has resigned as director of the zoological collections of the Academy of Science of St. Petersburg. Dr. E. Büchner has charge of the collections for the present.

Dr. K. Müller, of Halle, founder and, until recently, editor of the German periodical "Natur," has received the title of Professor from the German Government.

Dr. Carl Claus has resigned the professorship of zoology in the University of Vienna, and Dr. B. Hatschek, of Prague, has been called to the position.

Dr. A. Spuler, known for his studies of the wings of Lepidoptera, has qualified as privat-docent in anatomy in the University of Erlangen.

Mr. B. Waite, formerly of the Department of Agriculture at Washington, has been appointed professor of botany in Georgetown University.

Dr. D. Robertson, who devoted himself in past years to the Fauna of Scotland, died Nov. 20, 1896, at Millport, Scotland, at the age of 90.

Dr. G. Boccardi has been advanced to the position of professor extraordinarius of microscopical anatomy in the University of Naples.

Dr. S. Goto, who studied at Johns Hopkins and Harvard, has been appointed professor of biology in the First High School of Tokyo.

Dr. E. Baumann, professor of physiological chemistry in the University of Freiburg, i. B., died November 3, 1896, aged 49 years.

Dr. F. Czapek, of Vienna, has been called to the position of professor extraordinarius in the Technical High School in Prague.

Dr. L. E. Shore has been appointed tutor, and Dr. A. Eicholtz demonstrator, of physiology in the University of Cambridge.

Dr. R. M. Bolton, of Philadelphia, goes to Columbia, Mo., as instructor in bacteriology in the University of Missouri.

Dr. H. Trimen, director of the Botanical Gardens at Peradeniya, Ceylon, died October 18, 1896, at the age of 53.

Prof. M. Raciborski and Mr. H. Möller, of Lund, are spending the winter at the Buitenzorg Botanical Station.

Dr. J. Szádeczky has been appointed professor extraordinarius of geology in the University of Klausenburg.

Dr. Chas. Julin has been appointed professor of comparative anatomy in the University of Liége.

Dr. F. Noack has been placed in charge of the phytopathological laboratory at Campinas, Brazil.

The African traveler, E. D. Young, died at Hastings, England, Nov. 4, 1896, aged 65 years.

Dr. F. Westhoff, a well-known student of the Diptera, died Nov. 12, at Münster, i. W., aged 36.

Mr. O. F. Cook has been appointed curator of the Cryptogamic Herbarium at Washington.

A. Dorrsett, ornithologist and entomologist, died at Reading, England, November 6, 1896.

Dr. L. Serrurier has resigned the director of the Royal Museum of Ethnology at Leiden.

A. A. Heller has been appointed instructor in botany in the University of Minnesota.

Dr. H. J. Posselt, assistant in the Zoological Museum at Copenhagen, died July 10, 1896.

Dr. A. Pestalozzi has been appointed assistant in the Botanical Museum at Zürich.

Prof. A. Hénon, entomologist, died at Passy, France, Oct. 6, 1896, aged 74 years.

F. Benseler, of the Botanical Garden at Vienna, died Oct. 7, 1896, aged 67 years.

Dr. A. Dürmberger, botanist, died at Linz, Austria, Oct. 26, 1896, aged 59.

Prof. E. Wenzel, anatomist, of Leipzig, died Oct. 25, 1896, aged 56 years.

H. D. Van Nostrand, conchologist, of New York, died Oct. 9, 1896.

M. Chaper, conchologist, of Paris, died July 5, 1896.

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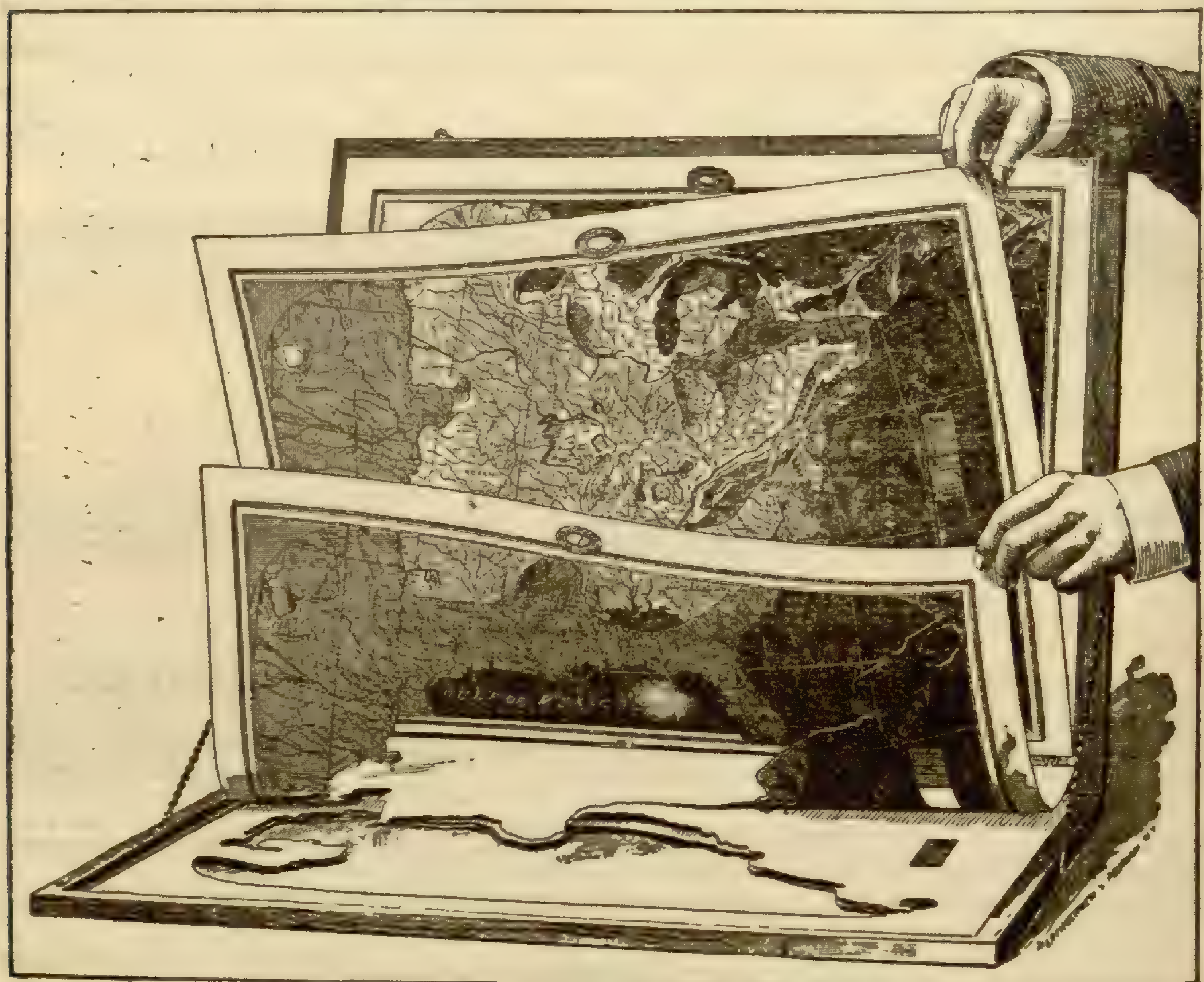

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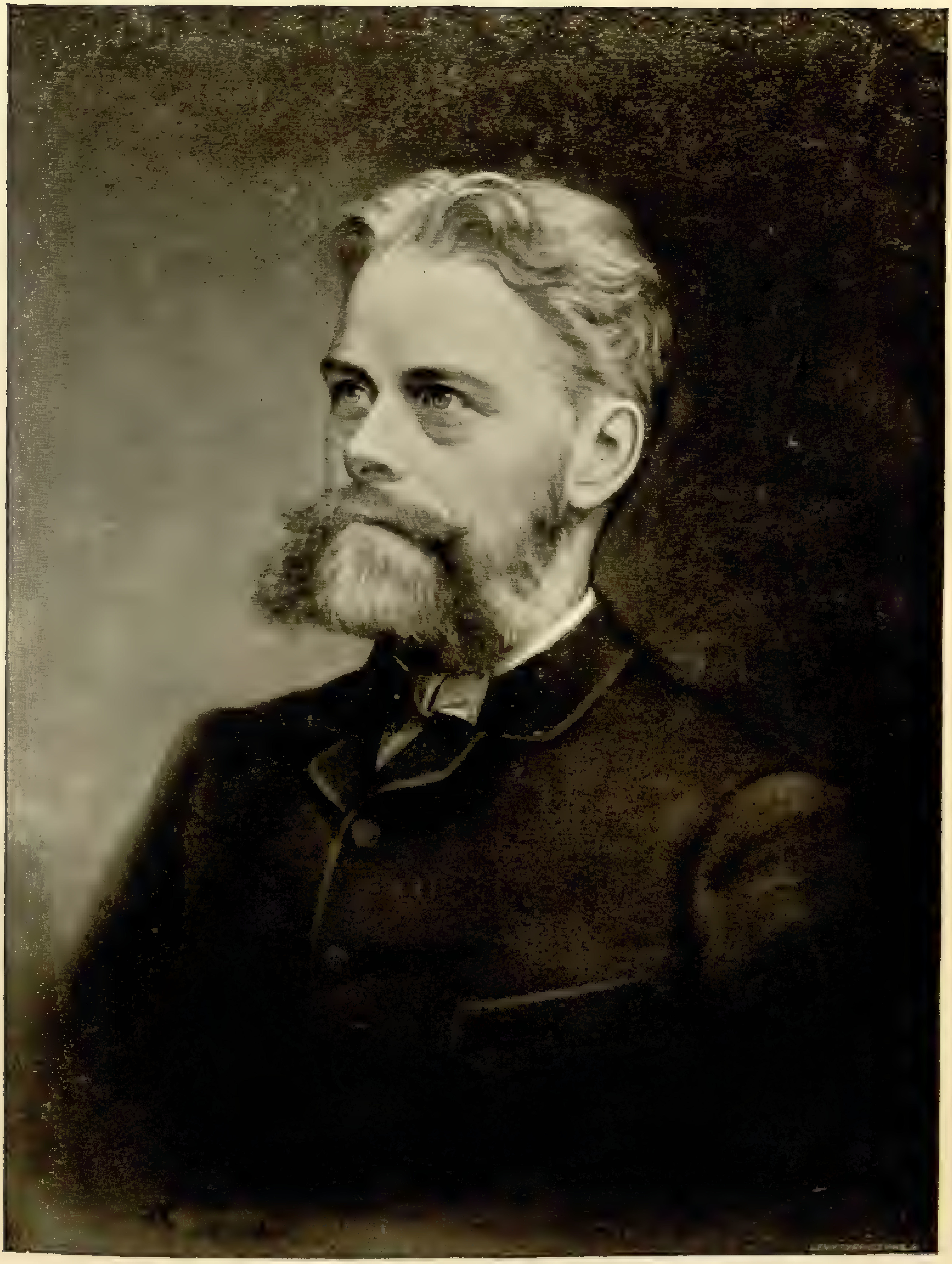

Edwd. D. Cope

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THE

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THE OPTIC LOBES OF THE BEE'S BRAIN IN THE LIGHT OF RECENT NEUROLOGICAL METHODS.

BY F. C. KENYON,

WASHINGTON, D. C.

While studying the central mass of the brain of the common honey bee, which I have already described with some detail,[1] there was abundant opportunity offered for noting the finer structure of the so-called optic lobes. From the casual observations then made I take the following notes.

The general form of the optic lobes, as well as the cellular and fibrillar masses composing them, have been fairly well described by Berger, Viallanes and others for other hexapods, and what one finds in the bee does not differ materially from these early descriptions, so far as the inner two fibrillar masses are concerned (f. m. 2 and 3). In the bee I note that there are three of these fibrillar masses, all easily recognized in frontal, but less so in horizontal sections (f. m. 1). The outer mass presents a lunar appearance in frontal sections, and lies close inside the basement membrane of the retina, being separated from it by sufficient space for the entrance of large tracheal sacs and a thin layer of cells commingled with the fibers from the retina.

---

[1] The Brain of the Bee. Journ. Comp. Neurology. Vol. VI. Fasc. 3, 1896. pp. 133–210.

Earlier authors, from the time of the first good description of the finer structure of the optic lobes by Berger, to Carrière and Viallanes, evidently did not understand the significance of this outer fibrillar mass. Berger and Carrière considered it as forming a portion of the retina, and Viallanes found in it, in the case of the dragon-fly, structures that he denominated neuromatidia—structures unrecognizable in the bee, and really without existence in any of the arthropoda. The earlier description given by Hickson much more nearly approaches the truth, but this author erred in supposing what he saw to be protoplasmic reticuli. The first correct understanding of this body was arrived at by Parker, in his application of methylene -blue to *Astacus.* But between the crustacea, as noted by Parker, and the hexapoda, there are certain differences of detail that are readily apparent upon a comparison of the figure accompanying this paper and that given by the author mentioned.

Somewhat inside of this mass is the first or outer chiasma (x)—to be distinguished as such only in horizontal sections.

Concerning the two inner fibrillar masses it is to be noted that each is composed of two lenticular finally granular, or better, in the light of the new neurology, finely fibrillated masses separated by a loose mass of fibers that never assume so dark an appearance in the ordinary stains. Each body would, if it were a perfect segment of a sphere, form a meniscus lenticular mass whose convex surface is directed outward.

From the middle or second fibrillar body two tracts of fibers pass into the central cerebral mass as noted in my earlier paper. Each arises from the inter-lenticular mass of loose fibers and emerges at nearly the same spot with its fellow on the anterior side of the body. One passes inward and upward, becoming what I have called the *antero-superior optic tract*, which finally terminates among the dendritic fibrils of the cells of the adjacent mushroom bodies (*a-s o. t.*). The fibers of this tract originate, as has previously been pointed out, from a group of cells lying above the optic body (*op. b*) and below the anterior surface of the calyx of the outer mushroom body.

The cells and their processes passing inward towards the stalks of the mushroom bodies can be readily distinguished in preparations by von Rath's platino-aceto-picro-osmic acid, or by my formalin-copper-hæmatoxylin, method, and in one instance I was able to follow through consecutive sections, in a bichromate of silver preparation, the entire course of the fibers from the cells in their antero-superior position in the central cerebrum to their T-like branching before the outer stalk, and thence into the inter-lenticular portion of the second fibrillar body.

The other group of fibers, after passing inward and slightly downward for a short distance, turns and passes backward between the inner fibrillar body and the central cerebrum, entering the latter posteriorly at a level below the roots of the mushroom bodies. This I have described as the *antero-posterior optic tract* (*a. p. o. t.*).

Just where the cells of origin of this tract of fibers are situated has not yet been determined. It may, however, be mentioned, that I have found in preparations by the bichromate of silver method, cells, situated near the anterior edge of the second fibrillar mass sending, in several cases, their processes into the loose inter-lenticular mass. It may be that these are the cells of origin of the tract (4).

Tracts of fibers are likewise found issuing from the interlenticular space of the inner or third fibrillar body. They are not, however, restricted to one spot in finding egress, but issue along the entire hinder margin of the body; and it is rather difficult to distinguish them otherwise than as the *posterior optic tracts.* Their number varies according to the plane of sectioning, and, it may be, also with different individuals. There are chiefly to be noted, however, first, an upper tract that seems to pass over the median line of the brain to the inner body of the opposite lobe. This tract undoubtedly gives off branches by the way, and it is possible that the cells of origin of its fibers are to be found on the posterior side of the brain below the inner mushroom bodies. At a level somewhat below the inner roots of the mushroom bodies there is another tract that takes a nearly straight course from one inner body to the other on the opposite side of the brain. From this tract Viallanes was unable to find evidence of lateral fibrillar branches in the central cerebrum, and, after all the methods employed by me, I am compelled to say that I have been able to do little better. In one preparation by my formalin-hæmatoxylin method there seems to be evidence of such branches; but I have found no such evidence in bichromate of silver preparations. Finally, there are several small tracts below the last that terminate in the adjacent region of the central portion of the brain, and in the neighborhood of the terminations of the antero-posterior optic tract.

The situation of the cells of origin of these tracts has not been definitely determined, but some of them no doubt may be found in the neighboring posterior mass of cells (5 and 6).

Two other tracts of fibres leave the inner fibrillar body. From the inner or concave surface of this there issue a large number of fibers that appear to be gathered up into two bundles. One of these passes forward as the *anterior optic tract* and terminates in the optic body (a, o, t; op. b), a small oval mass of fibrillar substance just above the antennal lobe. The other passes upward as the *postero-superior optic tract.* It joins the antero-superior tract for a short distance, and then passes behind the stalks and apparently into the calices of the mushroom bodies.

To this description and the one I gave in my former paper one might object, basing the objection upon the course and peculiarities of the fibers of the antero-superior tract, that since there is a tract of fibers connecting the inter-lenticular space of the second fibrillar body with the calices of the mushroom bodies, one would expect to find this posterior tract making similar connections with the inner body. The point was a difficult one to decide, and caused me an expenditure of considerable time in coming to a conclusion; but the evidence of my sections, both those by the formalin-copper-hæmatoxylin and those by the bichromate of silver, especially the latter, method, appears to be in favor of the description that I have given.

Considering now the denser mass of the fibrillar bodies it may be said that in sections treated by the formalin-copper-hæmatoxylin method one may find evidence of fibers passing through them in a direction nearly at right angles to their two surfaces. But such evidence is always fragmentary, and it is not until one employs the bichromate of silver method and thick sections that one is able to find unbroken individual fibres passing thus from one side to the other. Such fibers always show short arborescent branches in the outer and also in the inner lenticular mass. From the inner surface of the second fibrillar body they pass inward to the outer surface of the third body, which they enter, terminating arborescently a little below the surface. In this passage from one mass to the other they form, as seen in horizontal sections, a chiasma; so that a fiber emerging from the anterior side of the middle body enters on the posterior side of the inner body.

In many instances cellular connections were seen with the fragments of fibers crossing the masses and presenting the short lateral branches mentioned. In such instances the impregnated cells were found in the groups of cells lying anteriorly and posteriorly near the fibrillar bodies (2, 2′, 2″, 3, 3′, 3″). Their processes do not always enter the fibrillar bodies immediately upon reaching them, but run along the surface, curving around the fibers that do enter, and altogether presenting a somewhat lattice-like appearance when viewed at right angles to the surface of the body.

From the inner mass such crossing fibers have frequently been readily traceable into the anterior tract going to the optic body, but not into the postero-superior tract, which I was obliged to make out in heavily impregnated specimens.

From the outer surface of the middle body individual fibres have often been traceable nearly to the basement membrane of the retina, each posterior fiber crossing to the anterior side, forming with the anterior fibers the outer chiasma, and outside of this the peculiar palisade-like appearance that has been noted by the earlier authors.

Such fibers terminate proximally in the outer lenticular portion of the middle body in fine branchlets. Now and then a fiber entering this mass apparently from the palisade-like group of fibers gives off a few lateral branchlets and continues to the opposite side. Such cases I have interpreted to be the processes of the cells belonging to this middle body, but which have not been impregnated.

In other instances than those showing the fibers throughout their course nearly to the basement membrane of the retina, one finds fibers, or fiber groups, entering from each retinal element and continuing for some distance in through the palisade of fibers.

In some cases cells belonging to the group just inside of the basement membrane, which were described by Berger as the cells of the granular layer, are found impregnated and with their processes connecting with the fibres just described. In other instances fibers with short lateral branchlets are to be noted, the branchlets occurring in the region of the outer fibrillar body.

From the details noted it appears that the elements from the retina terminate each in a small tuft of fine branches in the outer fibrillar body, and come in contact with the fine lateral branchlets given off in the same region by fibers originating from the cells in Berger's granular layer. These latter fibers, forming elements No. 1, then continue on through the outer body, forming the palisade-like arrangement of fibers and the outer chiasma, and finally terminate arborescently in the outer lenticular mass of the middle body. The reasons that fibers from the retina seem to cross the outer body, forming a continuous passage between the basement membrane and the middle body is, it seems, that the lateral branchlets of elements No. 1 are very short, and the two small fibers are so closely applied together as to appear as one where they are heavily impregnated with bichromate of silver.

From the elements forming the optic lobes of the higher crustucea, as described by Parker, these and the elements belonging to the middle and the inner fibrillar bodies, noted in the figure as elements 2 and 3 respectively, differ in not forming a T-like figure, or in having a group of short lateral dendrites rather than one dendritic branch. This difference, it is plain, depends upon the location of the cell-body of the element. In the crustacea the latter, as shown by Parker, is situated between the fibrillar bodies that the two branches of its process connect. In the bee it is situated outside of the outer of the two bodies that are connected.

In summarizing the matter as just described, and as shown in my drawings and sections, it appears that, setting aside the outer or retinal elements, there are concerned in the transmission of visual stimuli to the central portion of the brain some six or seven neural elements, and that such stimuli may reach (1) the optic body, (2) the mushroom bodies, and (3) the hinder lower portion of the brain, and that they may pass over one or the other of the optic commissures—provided the upper one is a real commissure—to the inner fibrillar body of the opposite lobe, and thus indirectly reach the mushroom bodies, the optic body, and the posterior region of the brain on the opposite side. Further, it may be seen that there may be either three or four, or possibly more—but at least three—neural elements concerned in the transmission of a single stimulus. Thus, a stimulus may reach the optic body, the mushroom bodies, and the lower posterior portion of the brain as follows:

The mushroom bodies,	
By three elements,	1 a—2 b—(a.–s.ot.r.) or 1 a—2 b—3 d.
The optic body,	
By three elements,	1 a—2 b—3 d.
The lower-hinder brain,	
By three elements,	1 a—2 b—(a.p.t).
By four elements,	1 a—2 b—3 d—(p.o.t.).

Further it appears that a single stimulus might reach all three cerebral centers.

This explanation seems to accord best with the existence of two sets of fibrillar branchlets upon one element (b.c. and d.e.); but it must be held to be hypothetical, since I have not been able to ascertain definitely whether the terminals of the fibers of the posterior, the antero-superior, and the antero-posterior optic tracts connect only with the secondary branchlets (c and e). If connections are made with the primary sets (b and d) then the matter becomes much more complicated.

EXPLANATION OF PLATE.

(DIAGRAMATIC.)

a, a′, a″.	Outer fibrillar connections in the outer fibrillar body.
a.o.t.	Anterior optic tract.[2]
a.–p.o.t.	Antero-posterior optic tract.
a.–s.o.t.	Antero-superior optic tract.
b, b′, b″.	Fibrillar connections in the outer lenticular mass of the middle body.
b.m.	Basement membrane of the retina.
c, c′, c″.	Fibrillar connections of the inner lenticular mass of the middle body.
d, d′, d″.	Fibrillar connections of the outer lenticular mass of the inner body.
D.c.	Dorso-cerebrum.
e, e′, e″.	Fibrillar connections of the inner lenticular mass of the inner body.
f.m. 1, 2, 3.	Fibrillar bodies 1, 2 and 3, or outer, middle, and inner.
l.o.c.	Lower optic commissure.
p.o.t.	Posterior optic tracts.
p.–s.o.t.	Postero-superior optic tract.
st.	Stalk of the outer mushroom body.
u.o.c.	Upper optic commissure.
4, 5, 6.	Supposed location of the cells of origin of the fibers of the *a.–p.o.t.* and the *p.o.t.*
x.	The outer chiasma.
z.	The inner chiasma.

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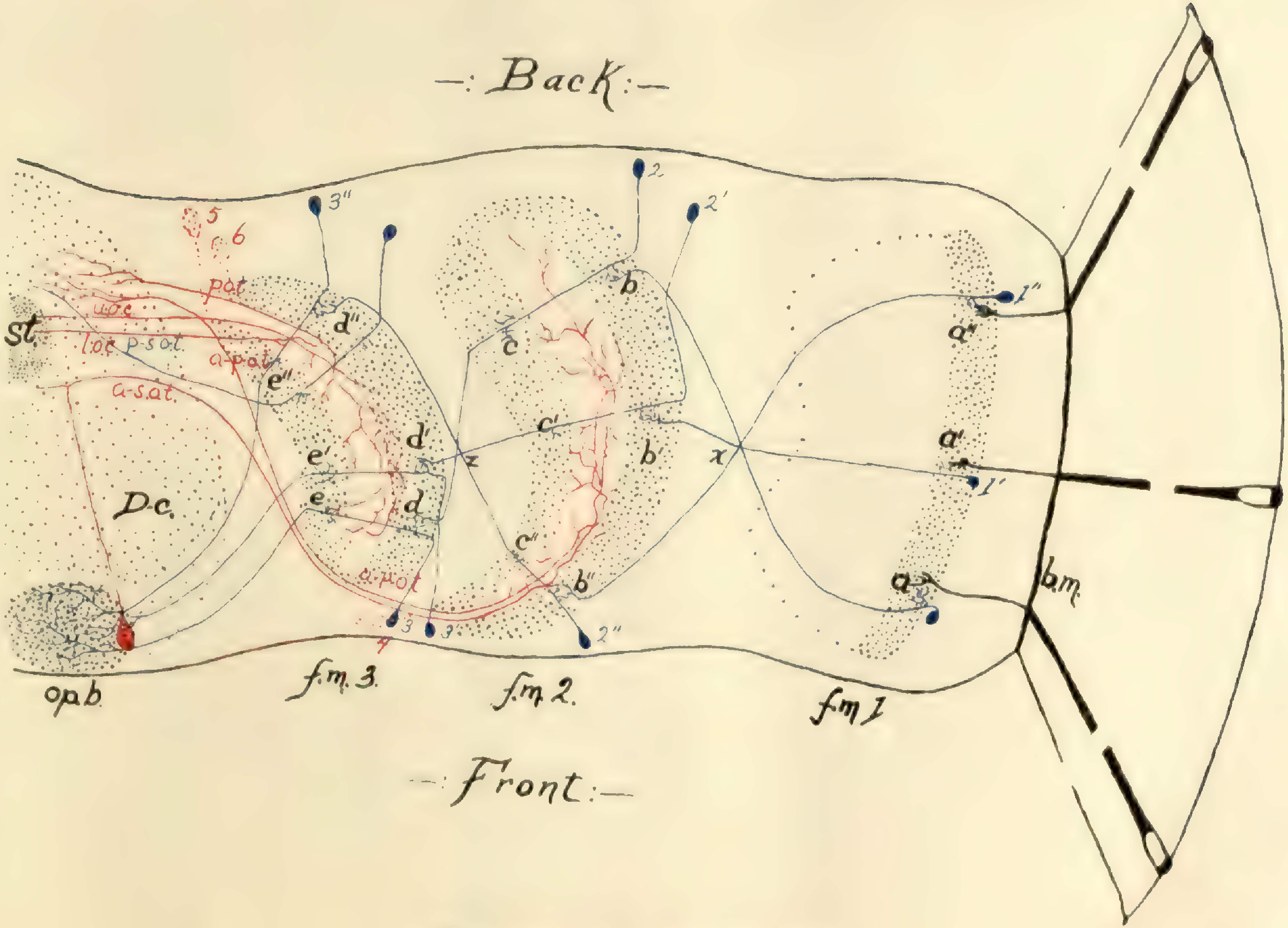
[2] The tract to the optic body (op. b.)

PLATE IX.



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a
a-pot
3
3'
4
2"
b.m.
op.b.
f.m. 3.
f.m. 2.
f.m. 1.
Front

The Optic Lobe of the Bee's Brain.

SOME NOTES ON THE FLORA AND FAUNA OF MAMMOTH CAVE, KY.[1]

By R. Ellsworth Call, Ph. D.

In 1889 there was published by the general government Dr. A. S. Packard's "Cave Fauna of North America, with Remarks on the Anatomy of the Brain and the Origin of the Blind Species," which constitutes the most complete treatise on cave animals which has appeared in this country. In that work there were listed eight genera and nine species of Infusoria, three genera and species of Vermes, four genera and species of Crustacea, eight genera and species of Arachnida, one of Myriopoda, twelve genera and fourteen species of Insecta, and two genera and species of fishes, all from Mammoth Cave. Dr. Packard also adds a list of seventeen forms said to be living temporarily in the cavern, most of which are listed on the authority of others. Of these one, *Spelerpes* or cave salamander, is listed on the uncertain authority of one of the guides. Excluding this list of seventeen, which includes three forms of *Helix* which most certainly came in from without, after death, and in floatwood, there remains a total of forty-one species. Seven of these are uncertain either in their generic or specific relations, as appears from the mark of doubt which is added to them. Of many of the forms concerning which there is no manner of doubt there are excellent descriptions and figures.

It is not my present purpose to speak of the forms which were known from Mammoth Cave prior to my own period of study, except in the most incidental manner. On the contrary, it is designed only to speak on the additions which more careful investigation has brought to light.

In the study of this new material the writer has been assisted by the following gentlemen, whose names are mentioned both that the fullest credit may be given them and that their high authority may attach to the determinations of the several forms as being new. For the *Diptera*, Mr. D. W. Coquillett, of the Department of Agriculture, Washington; for the *Acarinæ, Thysanuræ, Therididæ* and related forms, Mr. Nathan Banks, of Sea Cliff, New York; for the microscopic plants, Dr. Roland Thaxter, of Harvard University. It is quite sure, therefore, that the determinations in these groups are quite accurate and authentic. For the single mollusk and the larger fungi the writer is alone responsible.

---

[1] Read before Indiana Academy of Science, December 30, 1896.

The conditions under which collections are made in Mammoth Cave are not of the simplest character. The cavern itself is very great, and the forms of life neither large, as a rule, nor abundant. Hours may be spent by a novitiate without any success attending his efforts, and it is only after much search and repeated failures that he begins to realize that the distribution of life within the cave obeys certain laws. Animals are not found everywhere; nor are they found in association, except in a few instances. Visitors frequently spend hours in the cavern and fail to see any evidence of life; but one who is somewhat familiar with the habits of insects soon discovers that the same principles which govern their distribution in the realms of light prevail in the subterranean world. In a short time one soon learns where not to look for life, a fact of as great importance to one whose time is limited as to know where to look. The darkness is inconceivably great, and hangs like a great burden on one who seeks the smaller forms. The crude methods of illumination avail to lighten but a small area at a time, and most of the forms appear to be sensitive to light while not possessing organs of vision; such, at least, is my conclusion after some years of collecting, though, it is true that the heat of the lamps may be the prime cause of the haste which many species evince when disturbed. From my experience in Mammoth Cave I have learned that it is practically useless to hunt for insects where the cave is very dry; regions of wet soil or sides are the most favorable localities for all the insecta. The smaller rills and springs in the cave usually contain an abundance of small crustaceans, but mainly of two forms; aside from these but one form of life is common in the water, or fairly so, and that is the small white leech. An undetermined nematode worm, two specimens in all, has been found by the writer in a small rill which furnishes the water to Richardson's Spring, in the Labyrinth. On the walls about such places the "cave crickets" abound, and under the flat stones along the way may be found the very small and white spiders, associated with the small white and delicate *Campodea cookei.* Occasionally a brownish beetle, *Anophthalmus*, scurries across the over-turned stone, or may be seen running rapidly over the moist sands. In a few localities, where decaying toadstools are found, or where decaying vegetation of other sorts occurs, small flies occasionally appear fluttering in uncertain way about the lamps or run rapidly over the wet sand. In a single locality appears the minute mollusk, which we herein describe, the only known form which is a true cave mollusk in this cavern.

To the list of cave animals which appears in Packard's monograph must now be added seven forms, which are new to science, and several forms which, while known, have not before been definitely reported from Mammoth Cave. Without exception the new forms are very minute, and this fact is in itself sufficient to explain their late appearance in lists of the cave fauna. Without attempt to arrange them into strict systematic groups it will be enough to say that there is one new mollusk, one new dipterous insect, two new thysanurids, one new psocid, one new pseudoscorpionid, two new acarinids, among the animals; while several others have been collected in sufficiently great numbers to settle doubts connected with their affinities, or to make absolutely certain previous doubtful records or their occurrence. This is true of the two dipterous forms hitherto listed as *Sciara* and *Phora*, without specific names.

The descriptions which follow are prepared from the material collected by me by the gentlemen whose names are appended to the several forms, and the species are to be quoted with their names in authorship. This paper for the first time presents these new forms to science; their authors should have the fullest credit in citations. These new forms may be described as follows:

THYSANURA.

"*Entomobrya cavicola* Banks. Nov. sp. (Plate X, Fig. 2.)

"Length 2 mm. Whitish hyaline, intestine showing through darker; clothed with rather long scattered bristles and finer, shorter hairs; head not broader at tip in side view; no eyes; antennæ one-third longer than the head, first joint very short, second twice as long, third shorter, fourth longest; legs short, two claws at tips; mesothorax no longer than metathorax; first abdominal segment indistinct, fourth longer than third or second, fifth apparently entire, blunt at tip; furcula rather slender, mucrones curved. Several specimens. Mammoth Cave, Kentucky." (Banks.)

This minute species occurs in very great numbers in a single locality, a side avenue which leads over the narrow passage called the Labyrinth to the top of Gorin's Dome, in the older portion of the cave. In collecting it I had to lie on my face with the lamp close to the ground, and on turning over a fragment of an old wheel-barrow, that had been in the cave for two score or more years, and was so rotten that slight effort only was needed to tear it to bits, these little insects would be seen running about in every possible direction and in great haste. They were both on the under surface of the fragments of wood and also on the earth under them in equal numbers; when disturbed in the attempt to secure them the characteristic jumping movement of the group availed here to make collection difficult. It was noticed that many of them in springing up in the air would rise to an extraordinary height for so small an insect, frequently two or even three inches from the board. Others would land in nearly the same place as that from which they started, having a kind of boomerang movement that was, at least, curious. A paper bag would have secured hundreds by taking stick and all; but, as is usual on such occasions, the paper bag was not at hand. It is interesting to note, that while they represented a generation that must have been a long way from their beginning in the cave, introduced, of course, from the outside world originally, they still retained the habits of their earlier ancestors and of the group, and sought, in the densest darkness, the security of the under surface of their shelters. It would seem that this habit, which is quite general for all the cave species observed by me, would be a strong argument in direct proof of the outside origin of the fauna as a whole. While many generations have passed these forms hide in the regions of perpetual darkness as completely and systematically as do their cousins and nearer relatives of the surface. It is further interesting to note that this species is eyeless, a fact to which Mr. Banks calls attention in his description.

"*Smynthurus mammouthia* Banks. Nov. sp. (Plate X, Fig. 1.)

"Length 1 mm. White hyaline. Eyes distinct; antennæ have the first joint very short; second twice as long; third equal to second; fourth much longer, divided into five parts, the basal one long, the following three short, subequal, and a longer, slender one at tip; all, except the last joint, with hairs at tip. Legs are moderately long, two claws at the tip, each with a tooth above, the outer claw as long as the width of the tibia. There is a small tooth below on the dentes before the tip, and a larger one on the outside at tip over the insertion of the mucrones; the latter are shorter than the dentes, finely serrate below and with curved tip. Quite a number of short hairs on the posterior half of the abdomen, and on the anal tubercle. Three specimens, Mammoth Cave, Kentucky." (Banks.)

Of these specimens one was found in association with the form described above, while two were found under damp stones near Richardson's Spring, in the Labyrinth. The form moves slowly about, under the influence of the heat from the lamps, but springs very like the *Entomobrya* when the attempt is made to take it. The white color alone enables one to detect it during its slow crawling movements; a considerable number escaped before they could be seized, dirt and all, by the forceps. I judge the species to be fairly common, since one of my notebooks records the form as occurring in some numbers as follows: "Small mite-like forms abundant under sticks near Richardson's Spring; with them are rare examples of *Anthrobia mammouthia* Telkpf." Mr. Banks' figures are very characteristic, and well illustrate the hairy character of the animal. It has only occurred to me in this single locality, but may be found at other places in the cave where there are similar conditions of moisture.

PSOCIDÆ.

"*Dorypteryx* (?) *hageni* Banks. Nov. sp. (Plate X, Fig. 4.)

"Length 1.5 mm. Wholly pale, except reddish-brown eyes and mandibles. Head, thorax, legs and hind segments of abdomen clothed with fine short hairs. Ocelli sometimes distinct, sometimes not; basal part of antennæ of three joints, rest missing; maxillæ plainly trifid; legs slender, tibiæ much longer than femora, tarsi three-jointed, basal joint longest; wings rudimentary; second segment of the abdomen very long and smooth, subcylindric, forming the greater part of abdomen, on the venter it is prolonged by a median triangular piece over the next segment; other segments much shorter, and tapering to the tip.

"Several nymphs from Mammoth Cave, Ky. This may be the species to which Hagen refers in Packard's Cave Memoir, but it certainly is not the *Dorypteryx pallida* Aaron, which differs in broader nasus, more prominent eyes and larger thorax." (Banks.)

A number of specimens were found under wet and decaying fragments of boards in the Labyrinth in a small pit under the way leading to the top of Gorin's Dome. In this locality are the accumulations of many years of replacement of old bridges and steps which lead up the steep declivity which is so near the Dome, and the debris, well decayed and crumbling, affords the richest collecting ground in the cave. Spiders, flies, beetles, crickets, myriopods, mites all are here and the largest series to be found at any single place may be obtained. The particular forms which are the subject of this description find abundant food in the microscopic fungi which here abound.

ACARINA.

"*Rhagidia cavicola* Banks. Nov. sp. (Plate X, Fig. 3.)

"Length .7 mm. Whitish, legs hyaline. Cephalothorax pointed behind, and with a distinct segment behind it and before the abdomen, cephalothorax plainly longer than broad, truncate in front, no eyes; the abdomen rather narrow at base, broadest toward the middle and broadly rounded at the tip, showing above faint transverse marks or sutures; legs rather stout, with scattered bristles; mandibles large, chelate, a little shorter than cephalothorax, directed slightly downwards; palpi a little longer than the mandibles, second joint three times as long as broad, third fully twice as long as broad, and with two bristles at the tip, fourth about as long as broad, with five or six bristles at the tip arranged in a somewhat radiate fashion.

"Several specimens, Mammoth Cave, Kentucky." (Banks.)

This mite is a somewhat common species, and is found on the under side of stones in damp stations; especially may it be found under stones on which the egg masses of the cave spider, *Anthrobia mammouthia* Telkpf, occur. I do not know whether it attacks these masses in any way, but the association is suggestive of that conclusion. The species is one of the smallest of the living forms found in the cavern, being exceeded in that particular only by the following one. It has only occurred in collections from near the bottom of the Bottomless Pit and in Blacksnake Avenue, in which Richardson's Spring is located. More than two-thirds of all the species known from Mammoth Cave came from near this station or at it.

"*Linopodes mammouthia* Banks. Nov. sp. (Plate X, Fig. 5.)

"Length .5 mm. Pale yellowish, legs paler. Body oblong, rounded in front and behind; cephalothorax as broad as long, a shining eye on each side distinct; abdomen globose, above a silvery T mark, dorsum with a few hairs above, longer ones at the tip, and small ones each side of anal opening; leg I very long and slender, femur I as long as body, tibia shorter, metatarsus much longer than body, tarsus shorter, apparently not divided, femur IV thickened; the mandibles form a rather elongate cone; palpi plainly longer, joints two and three and subequal, smallest at base and rather clavate in form, fourth smaller and shorter.

"Several specimens from Mammoth Cave, Kentucky." (Banks.)

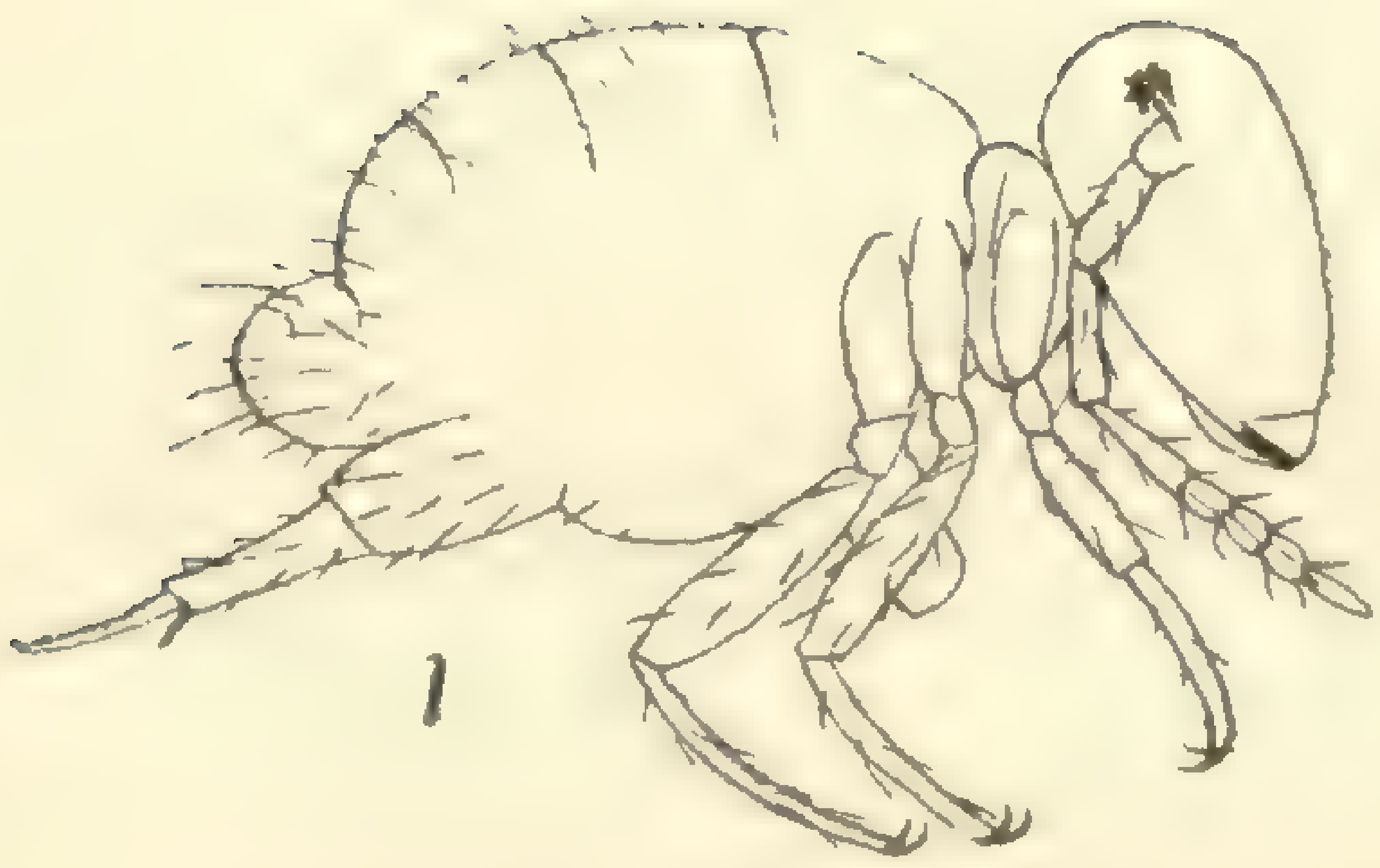
In all I have secured some fifteen specimens of this little acarinid, which is the smallest form yet discovered in the cavern. It occurs on the under side of damp stones and sticks, in association with the thysanurids, which are described herein, and is easily distinguished in collecting. The very long first pair of legs give it a most peculiar aspect, and as they are always in somewhat rapid motion they serve to discover the little insect to the observer. Then, too, the species has the curious habit of raising itself up so that it stands on the first and fourth pair of legs when disturbed. It is exceedingly slow in its movements. Vision is impossible in the cave, notwithstanding its bright eyes, and possibly the bristles or hairs of the posterior abdomen, on dorsal surface, have a certain tentacular function—using the word in the sense of organ of touch. It may be said that the species was originally detected, and subsequently always found, by lying prone on the ground and with the lamp as close as possible to both face and soil. The heat appears to disturb the minute specks of pale yellowish color, and they appear to move; then dirt and all were collected and transferred to the alcohol vial, and the microscope eventually discovered the animal. At the first and several following trials it was a matter of serious question whether I had really seen anything move, so small are the objects. Like many another form the original discovery of this one was an accident.

DIPTERA.

'*Limosina stygia* Coquillett. Nov. sp.

" Male and female specimens. Black, subshining, the palpi, front coxæ, apices of femora and bases of the tibiæ (most extended on the front pair), also bases of the tarsi and of the halteres, yellowish. Middle tibiæ each bearing a bristle on the outer side above the middle, a pair at the apex on the outer side and a single one on the inner side at the tip; hind tibiæ destitute of a spur at the tips; first joint of hind tarsi one and one-half times as thick as, but only two-thirds as long as, the second, twice as long as broad; second joint one and one-half times as broad as, and one and one-third times as long as, the third; remaining joints slightly broader than but only two-

PLATE X.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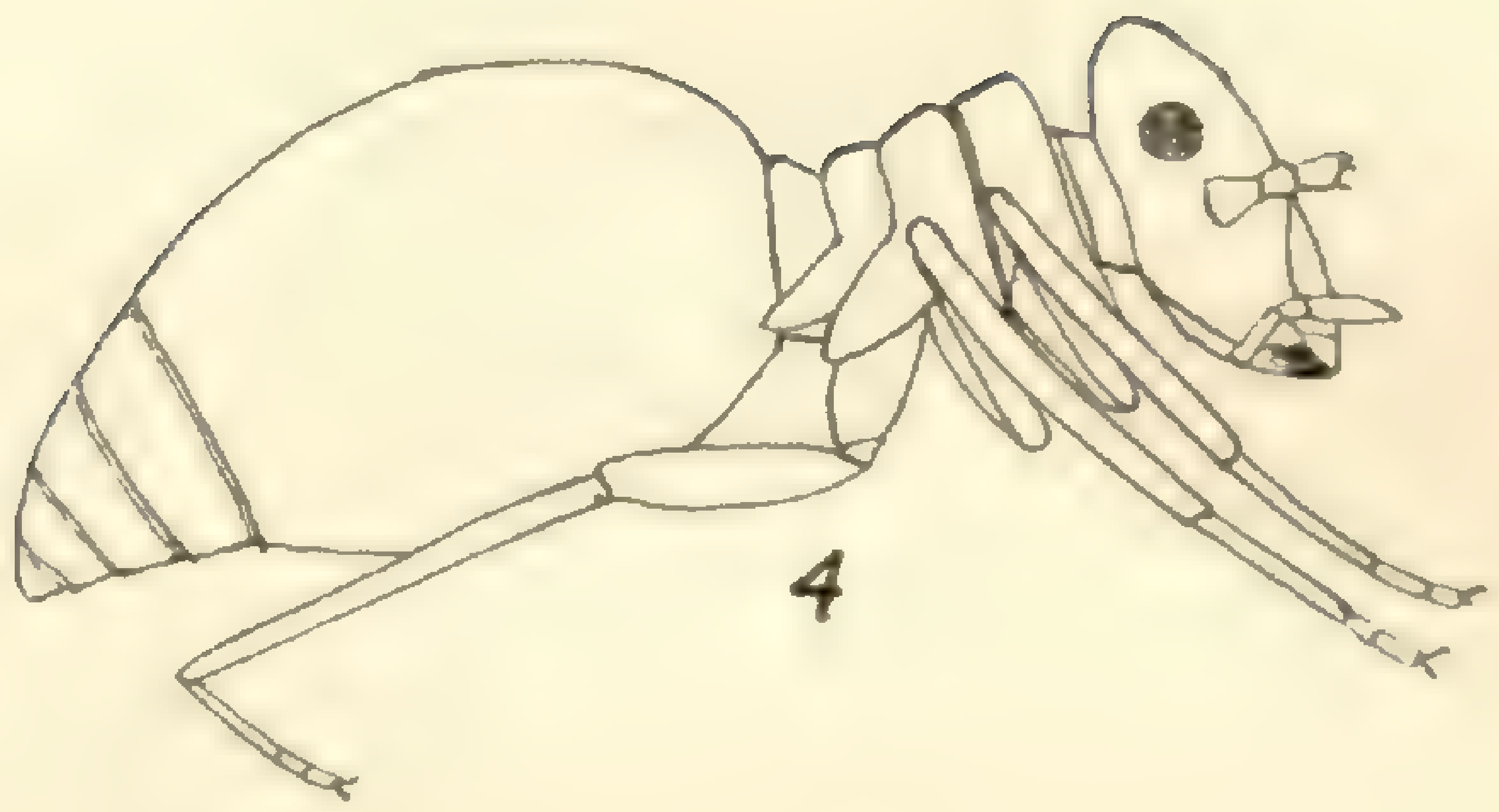
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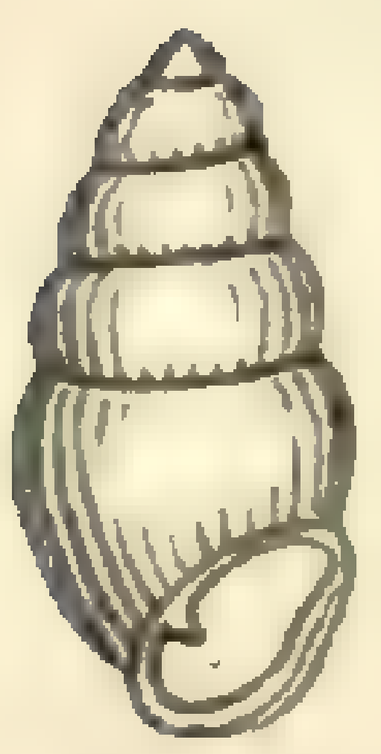
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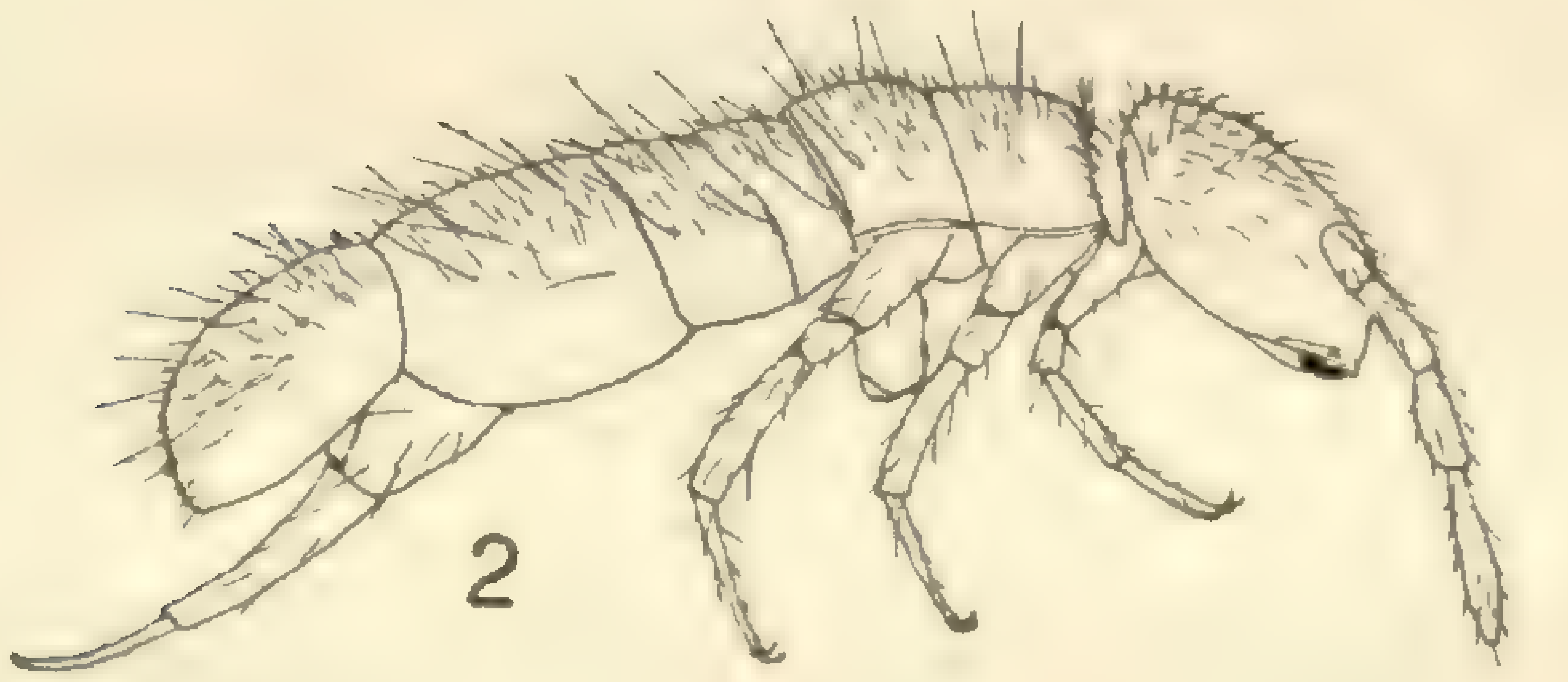
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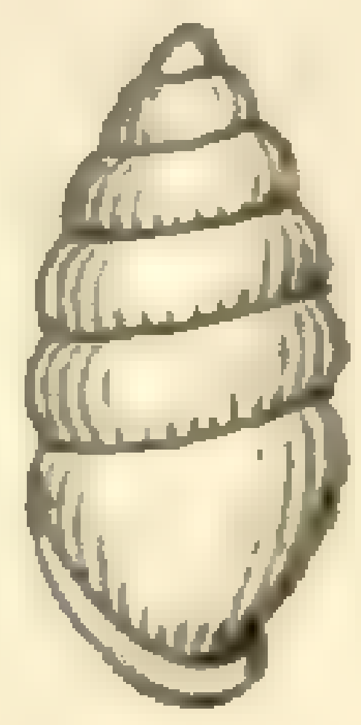
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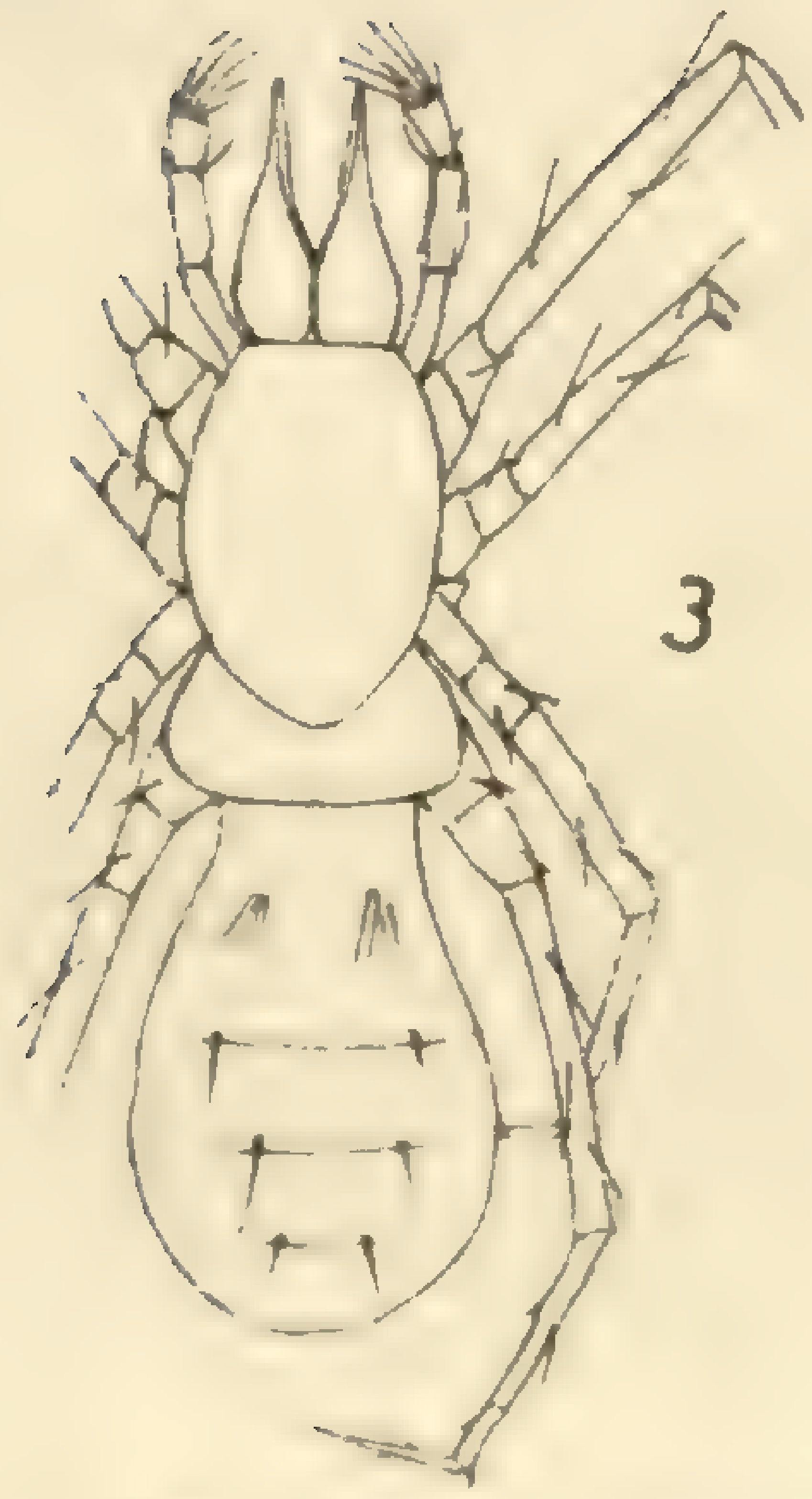
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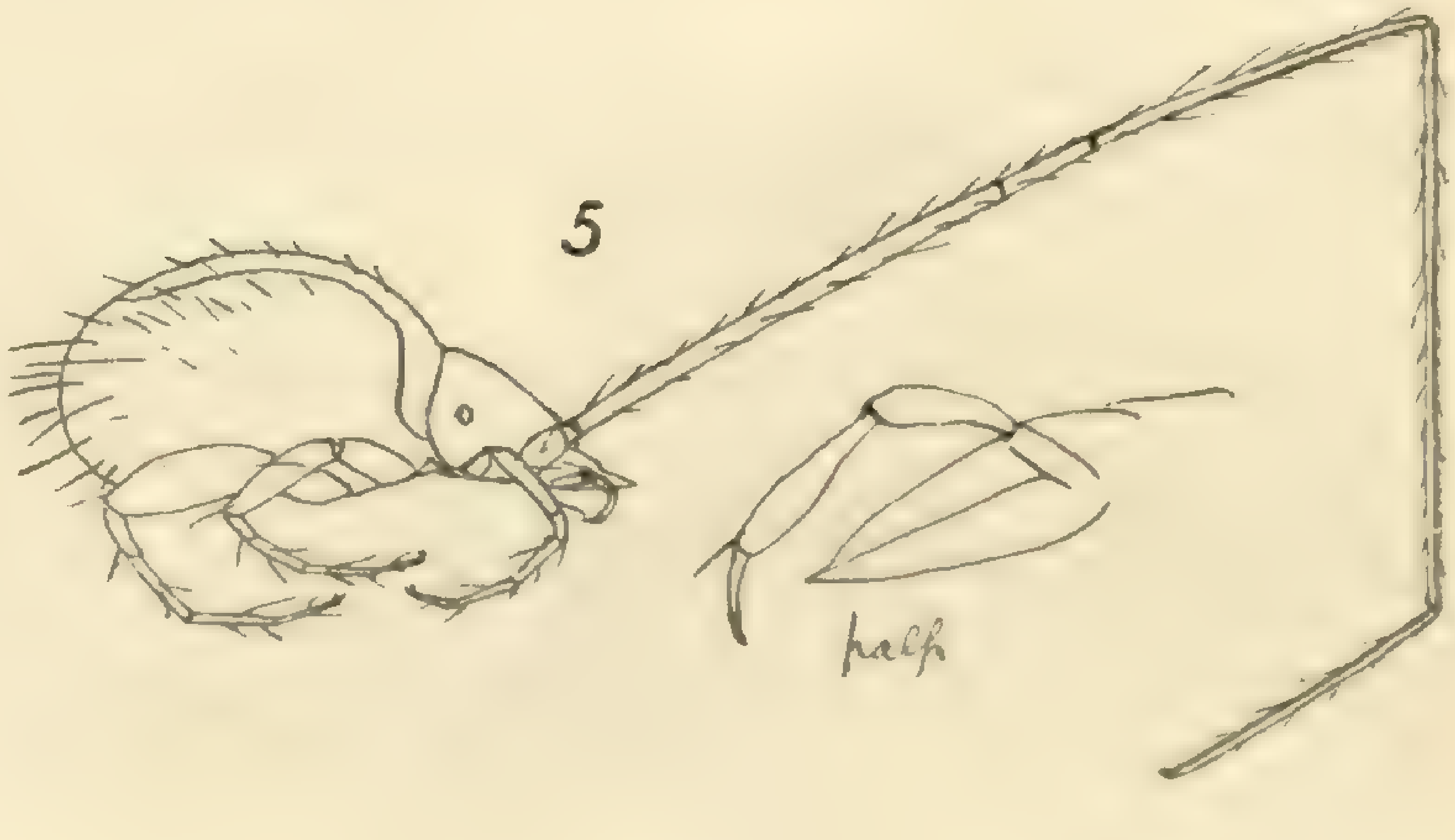
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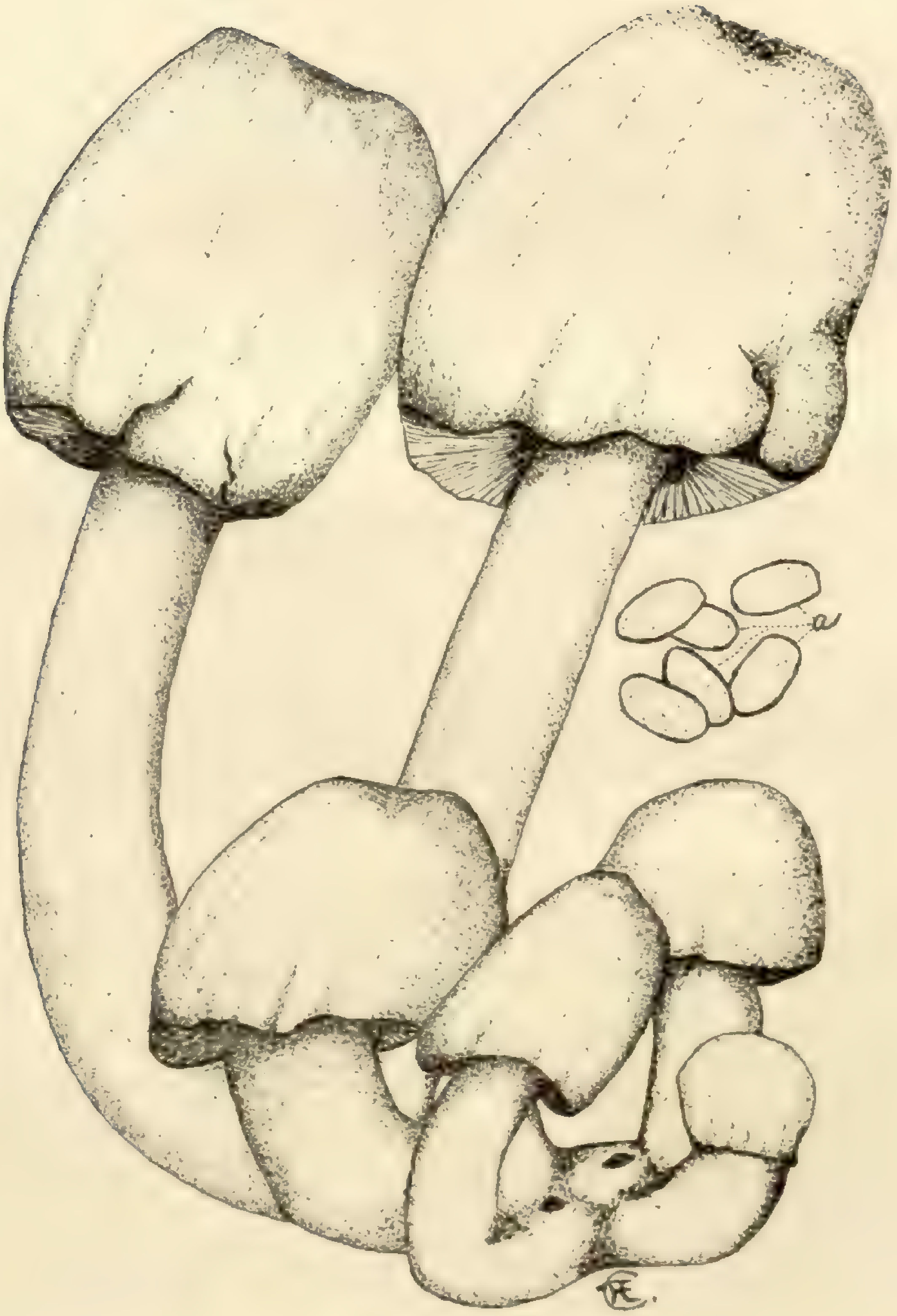
Fig. 1. *Smynthurus mammouthia* Banks. Fig. 2. *Entomobrya cavicola* Banks. Fig. 3. *Rhagidia cavicola* Banks. Fig. 4. *Dorypteryx* (?) *hageni* Banks. Fig. 5. *Linopodes mammouthia* Banks. Figs. 6–7. *Carychium Stygium.*

PLATE XI.



Coprinus micaceus.

thirds as long as the third. Scutellum bare, except for the four marginal bristles. Wings grayish hyaline, tip of second vein nearly midway between the apices of the first and third veins, third vein nearly straight, terminating close to the extreme wing-tip, fourth vein subobsolete beyond the discal cell, fifth vein continued beyond the hind cross-vein over one-half of the length of the latter, second basal and anal cells wanting. Length 1.5 mm. to 3 mm. Fifteen specimens, collected in alcohol, from Mammoth Cave, Kentucky." (Coquillett.)

A considerable number of additional specimens have been secured since the original lot which was forwarded to Mr. Coquillett, representing both sexes. These specimens and the original ones all came from the same parts of the cave, in which the species is fairly common. The number of individuals appears to be quite considerable, and many more could have been secured with a good net and proper appliances. The localities are all in River Hall, one near the Cascade, which is to the right of the visitor who crosses the Styx ; the other is near the head of Echo River. In both localities the floor of the cave is covered with a thick coating of rich mud, which contains enough dead organic matter to permit the rank growth of clumps of large hymenomycetous fungi of the genus *Coprinus.* In the decaying specimens of this fungus the flies are found, both in larval form and in imagos. They run about over the wet earth and clay rather briskly, or, if disturbed, fly a short distance and again settle down. The species is the smallest that is found in the cave. The body is, however, considerably heavier than that of the *Phora* which is herein described.

The two forms next following have been reported only by generic name from Mammoth Cave. The material collected by me was somewhat abundant, and definitely places these forms in the cave fauna. The original descriptions are given together with the bibliographic references ; these are followed by a new description prepared by Mr. Coquillett, based upon the males, in the first case, and upon specimens of both sexes in the description herein newly made.

Sciara inconstans Fitch.[2]

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[2] **First and Second Reports on the Noxious, Beneficial and other Insects of the State of New York, p. 255, 1856.**

"It measures 0.08 in length, and is black, with the thorax smooth and slightly shining, the thighs pale and whitish, and the wings pellucid and glassy, with an iridescent violet and red reflection." (Fitch.)

This very brief and incomplete description, without access to the types, would hardly enable recognition of this form. To it may be added the following:

"Male. Brownish-black; bases of the halteres, coxæ, femora and tibiæ, yellow. Antennæ as long as the body. Each apical joint of the hypopygium bears a cluster of short spines on the apical third of the inner side. Wings grayish hyaline, strongly iridescent, veins brown, fourth vein more slender than the others, forking at a point beyond the tip of the first vein, equaling the greatest width of the marginal cell, the anterior fork as long as the preceding section of that vein; last section of the first vein about as long as the preceding section; costa gently convex on the basal half.

"Female. Same as the male, except that the antennæ are only half as long as the body. Last joint of the ovipositor nearly one-third longer than broad. Length 2 mm. to 4 mm." (Coquillett.)

A number of specimens, over twenty in all, were obtained at several points in Mammoth Cave. One locality is in the small dome in the Labyrinth, near the Bottomless Pit; another, is the Mammoth Dome, in another part of the cavern; a third is at Richardson's Spring, in Black-snake Avenue; and another is at the bottom of Gorin's Dome. At Richardson's Spring was found an apple quite decayed in which hundreds of the larval forms of this species were found, and nearly a hundred secured. Careful search in suitable localities failed to disclose the puparium of this form. It appears to be quite abundant in the damper portions of the cavern.

Phora rufipes Meigen.[3]

(Translation.) "Black, halteres white, legs reddish-yellow, wings hyaline. It differs from the foregoing [*annulata* Meig.

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[3] Klassifikazion und Beschreibung der europaischen zweiflügligen Insekten, p. 313, 1804. (Work not accessible.)

Systematische Beschreibung der bekannten europaischen zweiflügligen Insekten, pp. 216-217, 1830.

=*rufipes* Meig.] only in lacking the white sutures on the abdomen. The male has a nearly conical, long haired body. One line."

Mr. Coquillett has prepared the following description from my specimens:

"*Phora rufipes* Meigen. Male and female. Brownish-black, palpi, halteres and legs yellowish. The four lowest median frontal setæ directed downward. Legs destitute of bristles except a pair at tip of inner side of each middle tibia and a single bristle at tip of inner side of each hind tibia. Abdomen of the male covered with rather long and nearly erect bristles. Wings hyaline, costa from base to tip of second heavy vein fringed with rather long bristles, second heavy veins forked at the apex, first slender vein arcuate at the base, then nearly straight to the tip. Length 2 mm. to 3 mm." (Coquillett.)

This species appears to be less abundant than either of the other dipterous forms. It occurs in Mammoth Dome and in the Labyrinth, in association with the *Sciara inconstans.* It flies about more freely, and when disturbed does not again light near by. In the Mammoth Dome I found the species running about among the masses of *Rhizomorpha,* which are so abundant on very old and decayed timbers in that portion of the cave.

MOLLUSCA.

Carychium stygium. Nov. sp. (Plate X, Figs. 6–7.)

Shell minute, white, pellucid, shining; whorls 5 to 5.5 in number, convex above and rather flattened below, apical whorl blunt-rounded in most specimens, occasionally more acute; suture deeply impressed, quite regular; aperture a little less than one-fourth total length of the shell, rather sharply angular above and broadly rounded below, with its plane forming a very acute angle with axis of the shell; lip reflexed in mature specimens; many examples, but not all, with a sharp, white, and long denticle on the parietal wall near the junction of the upper portion of the apertural boundary; the spire is generally quite regularly and narrowly conical, but the body whorl is somewhat turgid. The length of the shell is 1.5 mm. to 1.85 mm. The aperture is nearly as broad as long. (Call.)

About 150 examples of this minute mollusk were secured during various visits to Mammoth Dome, in Mammoth Cave. They were found on the wet surfaces of the old bridge timbers, in that portion of the cavern, which have remained undisturbed for fifty or more years. Growing on these in great tufts or masses, forming a shaggy mantle that enveloped the great timbers throughout their length, was a species of *Rhizomorpha*, a peculiarly modified and sterile form of basidiomycetous fungus; in the midst of this fungous growth occur numerous examples of this shell. Occasional specimens are found on the under surfaces of the wet rocks of this part of the cave, but none have ever been taken in a dry situation in the Dome. The constant dripping of water, which in the wet season is a stream falling from the roof 150 feet above, keeps the rocks and old timbers, with their fungous growths, all continually wet, and, except the utter darkness, makes the place a desirable home for "a well brought up" *Carychium.*

This species is much smaller in the relative size of the aperture and length of shell than its nearest ally *Carychium exiguum* Say. But it is a much heavier shell, far more rounded and shining than that form. *Carychium exiguum* from Indiana and and New York, with which I have compared it, is a much slenderer shell. Compared with the doubtful *Carychium exile* Lea it has a broader body whorl, is more conical, and has no striations, which are marked features of that form. Compared with the so-called *Carychium occidentale* the shape and size of the body whorl are different, the form of the lip and the curvature of the outer lip above are distinct. Since our form seems to be constant in all these differences it has been decided to present it under the name of *Carychium stygium.* Specimens may be seen in the Academies of Natural Sciences of Philadelphia and Cincinnati, and in the United States National Museum. The types are in the Call Collection at the Indiana State University, Bloomington.

The remainder of the new forms are plants, and but a brief mention will be made of them. Several of the lower fungi have been reported from Mammoth Cave, but most of them with doubt. Among the larger fungi Hovey has reported a species of *Agaricus*, which, however, seems to have been wrongly determined, since the form is a *Coprinus*. Collections were made at various localities; indeed, at all places in the cave where plant life occurs at all. While these have not all been carefully studied certain facts of interest have been gleaned. These now follow.

The largest form known in the cave is *Coprinus micaceus* (Plate XI). This occurs only in River Hall, near the Cascades and at various points between them and the head of Echo River. The last locality seems to be extremely well suited to them, for they grow in some numbers, and in clusters of several individuals. As is well known, the pileus of the *Coprini* is deliquescent. The particular form from the cave has black and rather large spores, and when, in maturity, the form deliquesces, it runs over a considerable area of the wet soil surrounding it and makes large black patches of sticky or gelatinous matter. In the midst of this black area, for some two or three days, the stipe will remain standing and afford attractive bits for *Adelops* and *Phora*, the first a beetle, the second a fly. In the pileus, before deliquescence is completed, the beetles and flies alike may be found in the burrows which the former have made. Many larvæ were obtained through a close examination of fifty or more specimens, at one time or another. The fungus itself thrives in the rich mud of the river banks, where sufficient organic matter is buried, and specimens have been seen with long and curled stipes of more than thirteen inches length. A locality where the species may always be found is at the third arch or landing on the Echo River, on the steep muddy banks of the river near the bridge.

On the old timbers in Mammoth Dome and on those of the little pit near Gorin's Dome, in the Labyrinth, occurred in great numbers a small *Peziza*, very light reddish-brown in color and thriving well, though growing in absolute darkness. In the Mammoth Dome the form must have long sustained itself, for it has been many years since timbers were placed there; unless, indeed, the spores were introduced in a very likely manner, on the smaller tree timbers, which are used in the construction of the railings and walks along the Styx and the Dead Sea. These are taken into the cave by way of Little Bat Avenue, and Mammoth Dome, being let down from the top, and thence taken by Spark's Avenue to River Hall. Whether this be the real manner of spore introduction matters little ; it is important to note that a form which almost commonly needs the light and warmth of sunshine to develop well here apparently thrives in absolute darkness and at a temperature which averages 54°.

In this same locality occurs the problematical form of basidiomycetous fungus, which is called *Rhizomorpha molinaris ?*, living in the greatest profusion on the old sticks and timbers which here abound. Some specimens of beams that have remained in the lowest and wettest portion of the Mammoth Dome for many years are covered from one end to the other with the long root-like filaments of this plant. The greater number of the living filaments were of a deep brownish color, shading into a very light red tip, which became colorless at the extreme end. They appeared to be covered with a " bloom " which was lost after touching them. Opportunity to again examine them might disclose the phosphorescent phenomena for which these forms are celebrated in mines, a fact not known to me at the time of their original collection. The species occurs in no other part of the cave.

At numerous localities, where there is some moisture, occurring on dead specimens of *Hadenœcus subterranea*, the so-called " cave cricket," is *Isaria* (*Sporotrichum*) *densa* Link. This fungus is one of the most beautiful when growing in suitable stations, the mass appearing as a flocculent bunch of cotton clinging to the walls or lying on the damp earth. I have found the form in many localities, but most abundantly in El Ghor and along River Hall. Associated with it is the yellow form to which the name of *Isaria* (*Sporotrichum*) *flavissimum* Link has been given. But the yellowish form grows less luxuriantly and is found on other decaying matter, while the first named occurred to me only on dead *Hadenœcus.*

A number of moulds and other low forms have been collected by me at different times, and been studied by Dr. Thaxter, of

Harvard University, to whom I am indebted for their determination. Among them are *Microascus longirostris* Zukal, *Zasmidium cellare* Fr., *Gymnoascus setosus* Eidam, *Gymnoascus uncinatus* Eidam, and several others that were indeterminate. There were collected also a probably new *Cœmansia* and *Papulospora*, a new *Bouderia* and two "apparently new species of *Gymnoascus*." It will be observed at once that many of these forms are well known ones, and in explanation of that fact it is sufficient to say that all came from the great hall beyond the Echo River, which is called Washington Hall, and which is the favorite lunch-station of parties on the "long route." On the debris of the lunches, on the chicken bones and half-filled egg shells, occurs a wealth of these minute forms. It would seem to be quite clear that they are introduced to this part of the cavern with lunches. Their internal distribution is mainly effected by means of the "cave rat," *Neotoma magister* Baird, which is abundant at this locality. These animals drag the bones and other remains of lunches to great distances, and the spores of the fungi are correspondingly widely distributed.

One of the most characteristic and marked forms that the casual visitor will notice is the widely spreading patches of snow-white fungus which covers the boards of bridges and hangs in beautiful festoons from timbers, or which spreads over a large area of wet earth from some water-soaked board as a center, especially in the Labyrinth and in River Hall. This is *Mucor mucedo* Linnæus, and is quite abundant. I have seen patches extending from an old timber that covered two square yards and others which quite covered the walls in some favored places. This plant is the most conspicuous fungus in the cavern. The others must be looked for especially to be seen.

At two places in the cave occurs a very abnormal species of *Fomes* (*Polyporus*) *applanatus* Pers., which is certainly introduced from the outside on the timbers on which it is found. The original form is illustrated by specimens which, on comparing it with the cave specimen, one may note the wide divergence from the typical form. Dr. Charles H. Peck says of this specimen: "It is, of course, very imperfectly developed, having no hymenium, as is usual when it grows in damp, dark places, as in caves, old mines, wells, etc. I have specimens from the coal mines of Pennsylvania in which the growth is much larger than this. I suspect it is an effort on the part of the plant to get to the light, and instead of the usual sessile pileus it makes an elongated stem-like growth. It grows on wood; and it is possible, in some cases at least, that the wood may contain the mycelium when it is carried into the cave or mine."

This great difference of form, in the light of the suggestion of Dr. Peck, is one of the most interesting botanical facts of the cave. The specimens, when fresh, had, at the reddish tip, a white, powdery bloom that gave a bleached appearance to the last inch or more of the specimen. It was found growing in a damp station not far from the Bottomless Pit.

These main new facts in the occurrence and distribution of cave insects and plants have been presented as a contribution to a knowledge of the life of the most interesting cave on the continent. Its great expanse renders likely additional discoveries on complete study.

METHODS IN ECONOMIC ORNITHOLOGY, WITH SPECIAL REFERENCE TO THE CATBIRD.

BY SYLVESTER D. JUDD.

The determination of the food habits of birds is of vast importance in rural economy. Owing to the ignorance on this subject, such a grave mistake as the introduction of the English sparrow was made. In order to ascertain the food of any bird, and to determine its relation to agriculture, a definite scheme of investigation must be followed. Until recently the method employed was that of observing birds while feeding; but this gave such fragmentary knowledge that distorted conclusions were drawn, and many innocent birds suffered, particularly the hawks and owls, until Dr. A. K. Fisher,[1] by the careful examination of stomachs, showed that of the 49 species of our hawks and owls, only 6 are injurious to agriculture.

[1] Hawks and Owls of the United States, Bull. 3, U. S. Dept. Agriculture.

The method of field work, which requires the united efforts of a botanist as well as an entomologist, yields results which must not be considered a final solution to the problem, but only a contribution to our knowledge. Nevertheless, field work is indispensable, since many interesting facts may be learned by going to fruiting trees or shrubs and watching the birds that visit them. This sort of work can be done to a limited extent in a field where grasshoppers are abundant; but with small insects this method of observation is almost impossible. Even if all the different kinds of food eaten could be ascertained in the field, the result would still be unsatisfactory, for the proportions of the various constituents would be unknown, consequently any economic conclusions would be impossible. The examination of the contents of the stomach is the "court of final appeal,"[2] because here the proportions of the different elements of the food can be determined. In researches in economic ornithology, under the direction of Dr. C. Hart Merriam of the U. S. Department of Agriculture, I have examined the stomachs of some 200 catbirds, and found that about half of this bird's food is fruit, while the other half is insects. Beetles and ants form the most conspicuous part of the insect food, and grasshoppers and smooth caterpillars rank next in importance, while spiders, myriapods and bugs are frequently eaten.

Although this method of stomach examination shows conclusively what has been eaten, it neither tells what has been refused nor does it give the preferences of a bird for one kind of food over an other. The reason for this is that the different elements of the food supply where the stomachs were collected is unknown. To obtain such a knowledge of the accessible food supply, and to learn just what insects and berries the birds had an opportunity of eating, I took an excursion on July 30, 1895, to one of the many gullies which intersect the bluff overlooking the estuary of the Potomac, to make observations on the feeding habits of the catbirds, and to collect data and material of the available food supply. The particular gully chosen was about eighty yards wide by twice as long, and extended back at right angles to the river until it rose to the level of the bluff. On the slanting sides of this depression a belt of catbriars (*Smilax*) afforded excellent cover for catbirds. Just above the catbriars and concentric to them was a belt of locust trees. The part of the gully next the river was swampy and supported a forest of willows, while the upper part was drier and afforded an abundance of ripe elder and blackberries upon which birds were seen feeding. The catbirds seemed to devote most of their time to berrying, though some were seen way up in the tops of the locusts, which had been browned as by fire by the locust leaf miners (larvæ of *Odontota dorsalis*), the adult beetles of which were swarming in myriads over the leaves. Several catbirds sang sweetly in the sassafras trees, which were sparingly intermixed with the locusts, while others were seen hopping on the ground where they had a chance to pick up grasshoppers, millers or ants. In all, 15 catbirds were seen in the little gully, and 13 of these were shot. Their entire digestive tracts were examined ; 9 of them contained the destructive locust beetle, 18 of these orange and black pests having been taken from one bird. This is surprising, because beetles of this family (*Chrysomellidæ*) secrete a substance which is supposed to be distasteful to birds. Every one of the birds had eaten elderberries, and all but two blackberries. Five of the 13 had taken sassafras berries, and 3 wild cherries. Both of these fruits were bright green and very hard. The eating of such apparently unsavory fruit, when there was a plenty of luscious blackberries seems, to say the least, a whim of aviam epicurianism. In the insect food of these birds there were no ants or grasshoppers, but, on the other hand, the supposedly distasteful locust leaf mining beetles. The countless number of these beetles, and consequently the ease of obtaining them, seems to be the only circumstance to account for the rejection of such favorite food as ants and grasshoppers. Not one of the false caterpillars (*Tenthredinidæ*) that were observed stripping the cornel bushes under the willows was to be found in the catbirds, thus showing that these larvæ are not eaten when the locust beetles are obtainable. From the knowledge gained by the study in this little gully, one would, with a fair degree of accuracy, be able to predict what kind of food catbirds would eat in another gully that had absolutely the same food supply. And so one might perfect this line of research until he could tell just which of the objects a, b, c, d, e, f, g, h in the accessible food supply of a locality a given bird would select.

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[2] Prof. F. E. L. Beal.

Let this suffice for the combination of the field work method with that of the examination of stomach contents. Very often birds that are too shy to be watched in the field may be kept in captivity and then offered various kinds of food. Such experimentation has proved a profitable adjunct to stomach examinations. Among the birds that I have experimented with were four catbirds, which had been recently trapped in the vicinity of Washington, D. C. Among the first insects offered to my birds were a dozen spiny black caterpillars (*Euvanessa antiopa*). The birds, though hungry, refused these repulsive looking creatures. By the next morning the caterpillars that had crawled out of the cage had pupated. I put one of these pupæ on the floor of the cage. It was eyed for some moments by a hungry bird and then devoured. Several days later the pupæ hatched into the brown butterfly which is so common in early spring, and one of these having been given to the birds, they fought over it and each finally obtained part of the insect. Beetles and ants were next tried. In order to prevent them from escaping from the cage, they were put on a piece of cork, which was anchored in a large drinking bowl. The birds soon became accustomed to the cork island with its cargo, and when all the insects had been eaten, often rapped on the cork for more. Bad smelling beetles (*Carabidæ*), which have been supposed to develop their stench to protect them from birds, were snatched as soon as they were put on the cork. Ants, which are highly flavored owing to the large quantity of formic acid which they contain, seemed te be regarded as choice food. Stink bugs (*Pentatomidæ*), whose nauseating odor is familiar to every one who has been berrying, were eaten by the catbirds, even when they had been well fed with other food. Large hard shelled beetles, such as *Passalus cornutus*, were refused by the catbirds, but soft insects, such as grasshoppers, spiders and smooth caterpillars were greedily devoured. Plant lice were not eaten, but the ants which tended them were quickly disposed of.

In making experiments with stinging *Hymenoptera*, I found that my catbirds refused to take honey bees; but a chewink ate one of these insects and died within fifteen minutes. Kingbirds, as a rule, eat only drone bees, but an instance is recorded of a bird that was found with a bee's sting implanted in its tongue. My catbirds regarded slugs (*Gasteropods*) as unsavory, but ate small snails. The birds relished thousand legs and earthworms.

By experiment it was demonstrated that beetle larvæ are regarded as dainty tidbits, but, owing to the fact that they live in such secure places as under sod or in rotten wood, they are seldom found by the catbirds, who has not the bill of the woodpecker to chisel them out, nor the sagacity of the grackle in following the plow.

Having ascertained what insects were eaten by caged catbirds, it will now be instructive to compare the results obtained by experiment with those arrived at by stomach examinations. Beetles formed, in the 200 catbird stomachs examined, the most important part of the animal food, and among these beetles strong scented *Carabidæ* were found oftener than any others. This family is very numerous in individuals, and consequently its members would be the insects which the catbird would most often have an opportunity of picking up. It was first supposed that they were eaten because of the ease of obtaining them and in spite of their offensive smell, until experiment demonstrated that catbirds regard *Carabidæ* as very palatable articles of food. None of the hard shelled beetles, which were refused by captive catbirds, were detected during stomach examinations; on the other hand, such soft animals as spiders and grasshoppers were found in large quantities, thus further showing the coincidence between the results of experiment and stomach examination. Both methods of investigation show that ants are much relished, and that smooth caterpillars are preferred to hairy ones.

Beside experimenting with insects, a series of experiments was conducted with the hope of ascertaining what fruits are preferred by catbirds. Equal volumes of cherries and mulberries were placed on the cork island, and at other times the experiment was repeated with strawberries in place of the cherries, and invariably the mulberries were selected. When there were any hopes of getting mulberries, the birds never touched strawberries or cherries. In the next experiment red and white mulberries were both put into the cage; the birds always took the red ones first. This last experiment showed that catbirds can distinguish colors. The whole series of experiments showed mulberries are preferred to cherries or strawberries, hence it may be inferred that these two latter crops can be protected from catbirds by planting mulberries. This preference for mulberries could not be deduced from stomach examination alone, for the reason that mulberries are not common in many places where catbird stomachs were collected. Experiments with other fruits would have been performed, if my birds had not been killed by a cat.

In recapitulation I would say that in investigating the food of a bird, the first thing to be done is to examine enough stomachs to obtain a general idea of the bird's food. After this has been done, one can intelligently go into the field and watch birds feeding. The different kinds of available food should be noted before collecting stomachs, then it will be possible to ascertain what the bird will eat, its preferences, and what it will refuse.

DR. ALEX. GOETTE ON THE DEVELOPMENT OF THE VERTEBRAL COLUMN.

By O. P. Hay.

In "Zeitschrift für wissenschaftliche Zoologie," Vol. LXII, pp. 343–394, Dr. Alex. Goette has published a paper entitled "Ueber den Wirbelbau bei den Reptilien und einigen anderen

Wirbelthieren." In this paper, besides detailing the results of his studies on certain lizards, the author considers views held or supposed to be held by Dr. E. D. Cope, Dr. G. Baur, and myself concerning the morphogeny of the vertebral column. In the present paper I shall endeavor to vindicate the position I have taken on the subject. Drs. Cope and Baur are capable of making their own defense.

My conclusions regarding the mode of development of the vertebral column were reached after a careful study of the young of Amia and a comparison of the results with the vertebral structures of other animals, living and extinct. These conclusions were set forth in "Publications of Field Columbian Museum," Vol. I, pp. 1–54; and it is to this paper that my distinguished critic refers. That paper really consists of two parts; the first part dealing with the structures of the adult axial skeleton, the second, beginning with page 25, treating of the development of the vertebral column in the young fish. The views expressed in the first part are somewhat modified in the second.

It may be well first of all to correct some errors into which Dr. Goette has fallen regarding statements made by myself. On page 381 of his paper he affirms that I found in the embryo of Amia, between the bases of the arches and the notochord, a dense layer of connective tissue, which later disappeared. I really found nothing of the kind, and I know of no expression in my paper which suggests it. A statement somewhat to this effect is, however, made by Dr. Gadow and Miss Abbott in "Phil. Trans. Roy. Soc. London," Vol. 186, p. 202; but there is no indication given that Goette had seen this publication.

On the same page of Goette's paper occurs the statement that I discovered that in dorsal region of Amia the upper intercalated cartilages push themselves under the succeeding dorsal arches, lift the latter away from contact with the notochord, and then fuse with them. Goette also refers to figure 10 of my paper as representing such a condition. The assertion indicates a complete misconception of both the text and the figure. What I said was that *at a very early period* these intercalated cartilages may have been fused with the arches. After they have once become distinct they never again fuse with the arches, and my figure represents them as being entirely distinct.

It is also to be noted that I disclaim holding the view that the intervertebral menisci of the Amniota have anything to do with the degenerated hypocentra.

A considerable portion of Goette's essay is devoted to a defense of a publication by Dr. Ludwig Schmidt, on which I made some remarks. I am unable to find anything in my former paper to the effect that Amia calva, being the most recent fish of the group, cannot possibly retain the embolomerous structure in case this were the older. It requires only a cursory perusal of that paper to discover that, after a study of the young of Amia, I did not regard the embolomerous condition as more recent than the rhachitomous. I need here only to call attention to page 41 of that paper.

Furthermore, I leave it to unprejudiced readers to decide whether or not I did Dr. Schmidt injustice when I affirmed that he had given two irreconcilable explanations of the way in which the simple vertebræ of the dorsal region had resulted from the embolomerous condition of the tail. Schmidt's first effort is plainly directed toward showing that the dorsal vertebræ have originated through the direct union of two such disks as occur in the middle of the tail. He describes and figures an abnormal vertebra which had been produced by the fusion of a "centrum" and an "intercentrum." He figures a section of this vertebra and calls attention to the "rudimentary arch" of the "centrum" and to the double-cone-shaped cavity between the two disks. Then, referring to the dorsal vertebræ, he notes their close resemblance to the united disks of the tail, the presence of the rudimentary arch, and then endeavors to explain the absence of the notochordal cavity on the ground of the very early union of the elements. This is a procedure wholly without point, in case one of the elements has become wholly or almost wholly reduced. Dr. Baur had already suggested this very natural explanation, and the only fault that Schmidt found with Baur's idea was that the latter regarded the "intercentrum" as the enlarged base of the lower arches, instead of a complete vertebral body.

From the consideration of the vertebræ of Amia from this point of view Schmidt turns to the discussion of its fossil relatives; and here he gives a different solution of the problem, the one that Goette endeavors to have us accept as the only one proposed by his pupil. The "intercentrum" is regarded as increasing at the expense of the "centrum," until in Megalurus and Amia the latter element is reduced to a mere vestige, the "rudimentary upper arch." The first method of union is that of two nearly equal elements, the latter the union of the lion and the lamb—with the lamb inside of the lion.

So far from being open to the charge of opposing the view that the dorsal vertebræ are constituted of elements homologous with those found in the somites of the tail, with reduction of some of them and expansion of others, that is the very pith of the embryological portion of my former paper.

I may remark here that in Amia the pleurocentral element can hardly be regarded as vestigial, since it appears to furnish the foundation for the upper half of the vertebral centrum. Not merely the small portion of the cartilage which is seen in front of the upper arch, but the whole of the cartilage in the upper half of the dorsal centrum, belongs to the pleurocentrum. The figures of Callopterus reproduced by Goette are very interesting, inasmuch as they show to what extent in that form the above element had become reduced. When the reduction becomes complete, the vertebral centrum becomes a hypocentrum, a condition affirmed by Cope to be that of the higher fishes in general.

Aside from any misunderstandings, there exist between Goette and myself certain differences which are fundamental. He holds that there is to be found in most vertebrates a specialized sheath which, composed of cells, surrounds the notochord and becomes segmented to form the "primary vertebral centra." This sheath, called in other publications "äussere oder zellige Chordascheide," is now named the "perichordal sheath." In some of Goette's writings it appears to be certain that he has in mind the elastica externa of other writers; in other papers it is evident that he refers to a somewhat specialized layer of cells belonging to the skeletogenous tissue. According to Goette, the arches, upper and lower, are formed in the skeletogenous sheath outside of this perichordal sheath, and only later become applied to it. The primary vertebra thus consists of the arches, upper and lower, and the ring around the notochord. Furthermore, Goette contends that, primitively at least, two such vertebræ belong to each somite. In few or no animals do we find both vertebræ present in all their parts, but the author referred to finds vestiges of them in even the highest vertebrates. I cannot subscribe to these views.

Without desiring to detract in the least from the merits of Goette's embryological labors, I believe that I am not wrong in saying that the importance, even the existence, of this perichordal sheath has not been recognized by vertebrate embryologists. Most writers deny that the alleged sheath is anything more than a portion of the general skeletogenous layer and hold that it graduates into the latter. Hasse appears to come nearer than others in recognizing a special layer of the skeletogenous tissue; but his "innere Zellschicht" does not appear to correspond wholly with Goette's perichordal sheath, since the former invests also the spinal cord. Furthermore, Hasse finds his layer of cells in Acipenser, to which genus Goette has denied the perichordal sheath.

It is very apparent too that in one great group of vertebrates, the Elasmobranchs, Goette's theory of the origin of the primary vertebral body has been demonstrated to be erroneous. Instead of there being, in these fishes, an "äussere Chordascheide" which has arisen as a distinctly specialized layer of the cells of the skeletogenous tissue, and which is a little later cut off from the less modified portions of this tissue by the elastica externa, it has been demonstrated by Klaatsch and Gadow and Abbott that the layer of cells called by Goette "äussere Chordascheide", takes its origin from migrating cells which, starting from the bases of the arches, have pierced the elastica externa and made their way into the fibrous mass of the elastica interna. The "primary vertebral centrum" of the sharks must then be a thing very different from what it is in the other groups of vertebrates.

Considering that the limits of the "äussere Chordascheide," its significance, and even its existence, are not yet agreed upon, the alleged product of its transformation, the "primary vertebral body" is a thing too intangible to be long considered in the presence of manifest realities.

Goette claims that in the tail of Amia the two disks belonging to each somite are two nearly equally developed vertebræ; it happening that only the arches of one of them are in a vestigial condition. I do not betieve that the elements which give rise to the two rings are equivalent. The arches, basidorsals and basiventrals of Gadow, arise at a later period than do the intercalated cartilages; at least they do so in Amia. The arches occupy a position essentially different from that of the intercalated elements, the former being placed intermyomerically, the latter myomerically. The arches have probably been evolved as a means for the fixed attachment for the muscular segments: the intercalated cartilages as a system of stop-gaps. Later these subordinate pieces have in many cases assumed a more important role.

I have been able to discover no reason for supposing that there is, in each somite of Amia, either one or two "primary vertebral centra." For, if by "perichordal sheath" Goette possibly refers to the elastica externa, this in Amia is certainly homologous with the structure so-called in the Teleost fishes and which, according to all recent observers, is not cellular. If by perichordal sheath Goette means a distinct layer of cells, which lies against the outside of the elastica externa and passes beneath the arches, then there is no such sheath. In my smallest specimens, 10 mm. long, a delicate layer of cells surrounds the notochord, but it does not show itself as a special layer under the bases of the arches, although the latter are not yet distinctly chondrified. Nor is there at any stage any such a well defined layer of tissue under the cartilages. Conversion of the arches into hyaline cartilage begins at a little distance away from the elastica, but when the process is completed, the cartilage comes into immediate contact with the elastica. Nor is there any modified layer of cartilage next to the elastica. Furthermore, when ossification begins, the layer of bone does not pass between the base of the arch and the elastica, but over the sides of the arch and against the elastica from an upper arch to one below it and to its fellow piece.

For the original duplication of vertebræ Goette finds evidences in the Urodeles, lizards, etc., in what he regards as the occurrence of vestigial upper arches, transverse processes, and ribs. These, it seems to me, are as yet of too uncertain nature for us to base on them any such serious conclusions as does Dr. Goette. They are probably susceptible of being otherwise homologised. Goette has reproached the palæontologists for deriving their theories from their palæontological, rather than from embryological, studies. But, are the embryological materials any more to be relied upon to furnish safe conclusions than are the materials used by the palæontologist? Under the strata of what countless generations the primitive structures have been buried! How many elements that once were prominent and perhaps all-important have been totally suppressed, or if vestiges of them remain in the embryo, how difficult it is to detect and to interpret them! How many adaptive modifications have been introduced into perhaps every species! Among the embryologists themselves there are many who declare that ontogony offers little reliable evidence regarding phylogeny. This I am not ready to admit. The palæontologist must not despise the embryologist; nor must the latter scorn the former. We shall do well if we succeed in explaining nature after we have made use of all her aids.

As regards the duplication of ribs, a doctrine of Goette's, one set for each supposed vertebral centrum, one pair must, so far as I see, have fallen in the intermuscular septum, the other in the middle of the myomere. The latter is a condition unknown, hardly conceivable. Two ribs placed at different levels in the same intermuscular septum might belong easily to the same vertebral body, as in the case of many fishes. How fortunate it is that the shad has not inherited a full complement of vertebræ and their appendages!

Goette objects to the views entertained by Cope, Baur and myself, since they lead to the conclusion that the vertebræ are not homologous throughout the various groups of vertebrates. They do not need to be homologous and are not so. The vertebral centra of the sharks, arising as they do from the invasion of cells into the elastica interna, cannot be homologous with those of the Teleostomes, which originate in a skeletogenous tissue outside of the elastica externa. An abnormal vertebra of the tail of Amia formed by coalescence of the two disks of a somite, is not homologous with one of the disks, even if we were, with Goette, willing to regard the latter as vertebræ. Nor is a simple vertebra of the dorsal region, made up as it is of parts of two alleged vertebræ, homologous with anything that we find in the tail.

Of course, Goette holds that the " primary vertebral centrum" is found in all the Digitata, and is developed wholly independent of the arches. So far as the Amphibia are concerned, I believe that the centrum is primitively derived from the arches, even in the fossil Branchiosauridæ. We do not need to suppose that cartilage has, in all cases, surrounded the notochord where bone is now found. As in Amia, the ossification may spread from the bases of the arches into the soft connective tissue lying against the notochord. It may even be so precocious in its appearance as to suppress the cartilaginous stage of the arches, as is the case with many fishes.

I find that in the young Amia a thin layer of cartilage is formed under the bone of the centrum, lying close against the elastica. It appears to spread from the bases of the arches, and is developed later than the bone. Possibly the ancestors of Amia possessed a more exstensively developed condition of this cartilage.

A comparison of the early condition of the vertebral column of the Urodeles with that of Lepisosteus brought me to the conclusion that the intervertebral cartilages of both are homologous with the " intercalated cartilages " of Amia, and Dr. Gadow in a recent publication has adopted the same view. Without attempting to explain all of Hasse's and Field's results, I believe that they are entirely in error when they affirm that the earliest rudiment of the vertebral centrum is a segment of the elastica externa, and that the cells of the skeletogenous tissue which develop into the intervertebral cartilages first make their way through the elastica. Whatever that earliest rudiment may be, it has nothing to do with the elastica externa. This is present, as it is in fishes, in close relation with the elastica interna. In the tail of young Necturus, where the bone is already well developed, the externa may be plainly seen as a highly refractive line between the interna and the centrum. But this is nothing new, since other observers have seen the externa distinct from the centrum.

As regards the lizards and other Amniota, I am willing to concede that there intervenes between the bases of the arches and the sheath of the notochord a distinct cartilage on which rest the bases of the upper arches. Goette's " primary vertebral centrum " found in the lizards I regard as the pleurocentrum, which has been pushed under the bases of the arches. If it is such, we might expect to find it starting in its development on the upper side of the notochord ; and Goette's figure shows at least that it is thinner on the lower side than elsewhere. I am ready to admit that in the Amniota the basalia, to use Gadow's terms, have formed unions with the interbasals behind them, instead of with those in front of them. The possibility of this was considered in my former paper, p. 51. Consequently, in the vertebra figured by Goette Figs. 1, 2, 7, the centrum has been pushed forward under the arch in front of it. It is quite possible that its original myomeral position is no longer reproduced in the embryo.

If our minds can once be freed from the idea of a primary centrum we shall probably find little reason for disagreement about the development of the vertebræ in the different groups. It seems to me beyond doubt that the rhachitomous vertebræ of the dorsal region of Eurycormus (Zittel, Handbuch, vol. 3, p. 230) must have been developed from the embolomerous vertebræ of the tail. We have seen how the rhachitomous vertebræ of the dorsal region of the young Amia unite to produce the definitive vertebræ. Thiollière's figures of Callopterus, reproduced by Goette, show us how, by the reduction of the pleurocentrum, the vertebral body becomes a hypocentrum. If now the pleurocentrum should grow at the expense of all the other elements, we would have such a vertebra as Cope and others find in the Amniota. And considering what we find in the temnospondylous Stegocephali, in the Clepsydropidæ, and in Sphenodon, I cannot refuse to believe that such a course of development has been pursued.

It appears to me unnecessary to suppose that the embolomerous condition has at any time resulted from the rhachitomous. In some cases probably the latter has grown out of the former; but it is by no means a necessary course. Probably in most cases the lower intercalated cartilages have suffered reduction before coösification has united them with the upper intercalated pieces.

THE SEVENTH SESSION OF THE INTERNATIONAL GEOLOGICAL CONGRESS.

This will probably eclipse any previous session in many respects and will enjoy the distinction hitherto conceded to the second, or that of Bologna, of being the most notable concourse of geologists, and of making the most important contribution to geological knowledge, both practical and theoretical, in the history of this Congress. Many circumstances conspire to produce this result. In the first place Russians share with Americans the reputation of being lavish in expenditure and prodigal in hospitality; it may be added of both nations also, that this extravagance is not diminished because it furthers some important project.

When at the London session of 1888, it was decided to hold the fifth session of the Congress in Philadelphia in 1891, the geological world was prepared to be astounded at the profusion of the hospitality and the generosity exhibited in the general management and especially in the long excursions. That the bacillus of Officialism infected this egg before it was laid in the wrong nest, and broke hope's promise as to its hatching, only has increased the zeal of the Russians to outdo their most dangerous rivals.

The next Congress was that of 1894 in Zürich, Switzerland, where there were rocks of the world's crust enough, but those of commercial value were not superabundant. While Switzerland did herself credit, therefore, nothing was done which deprived the Bologna Congress (1881) of the right to be considered the most successful and brilliant thus far held. The Russians thereupon secured the favor of the Tsar and of his Ministers and called to their aid all the official and other geologists of the Empire.

The large cities and towns, the wealthy syndicates and proprietors, all united in the efforts to draw to Russia the largest possible number of scientific men, and to conduct them over the maximum of Russian territory in order that the resources of that enormous realm (or rather of its European part) might become known as they never have been known before.

By imperial decree the Consuls in all foreign countries have been notified to facilitate to the utmost degree the viséing of passports upon presentation of the card of membership of the Congress. This same card entitles the owner to gratuitous transportation over the entire system of Russian railways. It will also enable the possessor to pass his baggage and effects through the frontier, with the minimum amount of embarrassment from Custom House regulations. Finally objects marked for the Geological Congress may be sent without being opened at the frontier to St. Petersburg, and there opened in the presence of an officer of the Congress. The business to be transacted at the meeting of the Congress will be referred to hereafter. Equally important are the opportunities for the masters of the branch of science to meet each other and discuss face to face the problems which hitherto have been debated at long range and through the desultory and uncertain medium of scientific journals or comptes rendus in different languages, the illustrations and nomenclature of each party to the controversy being drawn from his own land.

But most instructive of all the customs has grown that of bringing the students from other lands face to face with the most striking geological phenomena of the country where the Congress is held. To do this excursions are arranged and conducted by the best geologists of the nation acting as host and the foreign members are furnished with a "livret guide" or pamphlet containing maps, sections and a digest of the literature bearing upon the regions to be examined. This was done in Switzerland and the little book is one of the most valuable of the souvenirs of the Congress.

These Congresses have grown out of a resolution presented by the late Dr. T. Sterry Hunt in a meeting of the A. A. A. S. in Buffalo in 1876 to the following effect: "*Resolved,* That a Committee of the Association be appointed to consider the propriety of holding an International Congress of Geologists at Paris during the International Exhibition of 1878, for the purpose of getting together comparative collections, maps and sections, and for the settling of many obscure points relating to geological classification and nomenclature.[1]" The above Committee instead of "reporting on the advisability," etc., went to work, and with the assistance of numerous foreign members actually organized a central bureau in Paris, where the first Congress was held in 1878. After laying down the plan for future work, this Congress fixed the dues of membership at 12 francs, and created two Committees; one for the unification of the conventional geological symbols, and one for the unification of the nomenclature.

The next Congress was held in Bologna in 1881, and thanks to Prof. (now Senator) Capellini and his influence with the Italian Government, the most important progress up to the present time was made, and the proceedings were perpetuated in a volume which is a monument of good taste in typography and illustrations, and of scientific research in its contents. It decided to produce under the direction of the Congress a geological map of Europe, confiding its execution to Profs. Beyrich and Hauchecorne of Berlin.

The third Congress was held in Berlin in 1885, the year 1884 which would have been the next date for the Triennial

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[1] About the same time and entirely independently, Prof. Giovanni Capillini made an almost identical proposition to certain influential geological friends.

Congress, having been allowed to pass without ono wing to the fear of the cholera which had invaded Southern France.

The fourth Congress was held in London in 1888, the fifth in Washington in 1891, and the sixth in Zürich, Switzerland, in 1894.

At the latter a special committee was appointed to select the topics which should occupy the attention of the members of the Congress. These topics have not yet been announced, but the reports of the committees on the unification of nomenclature, that of the committee on the production of a geological map of Europe (of which several parts have been issued since the Zürich Congress), and the special committees appointed by the last Congress; one under Prince Roland Bonaparte, on glacial phenomena, another under Prof. Michel Levy on petrography, and a third under Emm. de Margerie on bibliography (which has issued a valuable volume) will furnish plenty of material to occupy the five days of the meeting from the 28th of August to the 4th of September.

Preceding the session three contemporaneous excursions will be made. One of about 350 miles from St. Petersburg into Finland, one a little shorter into Esthonia, and a long excursion of 2300 miles lasting twenty-eight days over a most interesting part of the Ural Mountains on the borders of Asia as far as Ekaterineburg on the sixtieth degree of east longitude (east of the entire continent of Africa and about on the meridian of Mauritius).

After the Congress another choice of excursions will be made from Moscow SE., S., or SW. through Southern Russia in Europe to Wladikavkaz, where the three parties reunited will pass over the military road crossing the great Caucasus, and after visiting Baku, Batoum and other places, and traversing the Black Sea to Kertch and Yalta dismiss at Sebastopol on October 5th. The longest of these attractive excursions will not be less than 2700 miles.

Such a stupendous scale of entertaining visiting geologists is without precedent, and if the war clouds of the Levant but disperse, a long stride will have been gained by western savants in an understanding of the geological enigmas of European Russia.

Persifor Frazer.

THE PICTURES OF PROF. E. D. COPE IN THIS NUMBER.

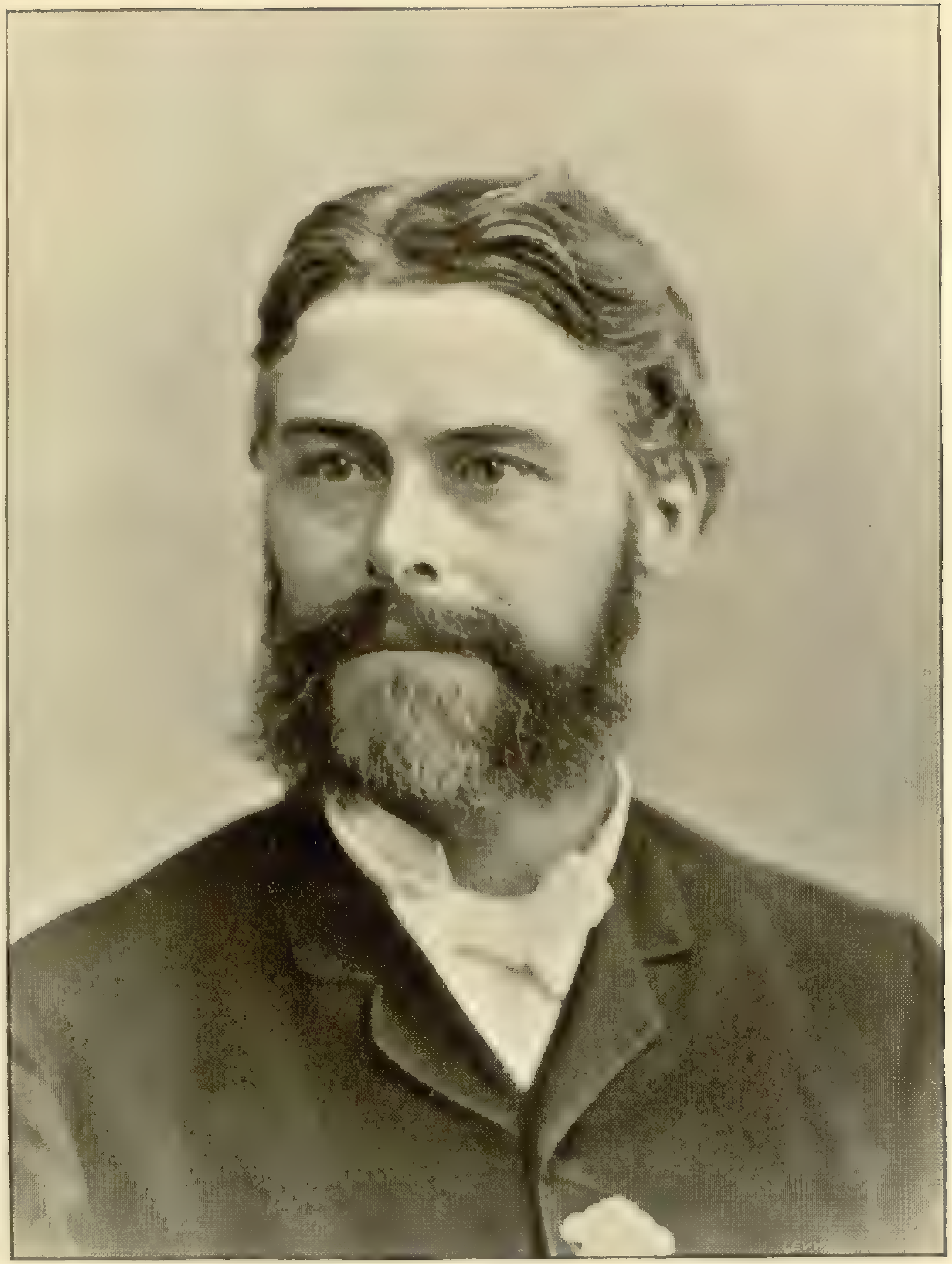
The picture which occupies the frontispiece of this number was painted by Mr. George W. Pettit of Philadelphia as a labor of love, and the study of the head of a remarkable man. Without at all compromising its accuracy as a portrait, Mr. Pettit has succeeded in imparting to it a great deal of the intellectual force which was familiar to all those who knew Prof. Cope intimately. As a representation of the man it illustrates the advantage which a faithful painting has over a photograph. The latter is an accurate reproduction of the object as it was at a given minute. All appearances have equal value during this short time; the accidental and transitory as well as the permanent and characteristic. Indeed some of the latter may and usually are masked by the former and possess less than their true significance in the resulting image. On the other hand the portrait by an artist is a composite of a great number of pictures preserved in his memory, in which the salient characteristics survive and the transient and adventitious expressions disappear.

This is well illustrated by the present portrait which was begun ten years ago or more, and has been so gradually evolved that it may be said to embody the essence of the original's aspect during that period. The beard is shown as it was worn during the greater part of the subject's life, and as most of his friends will remember it. During the last two years he had dispensed with it entirely as is manifest from the picture which has accompanied the greater number of the sketches of his life in newspapers and journals. This picture while pleasing in its expression, enforces what has been said of the advantage which a portrait study by an artist has over even the most agreeable photograph. The intellectual expression implying alertness and activity which is so manifest in the painting (as it was in the face of Prof. Cope himself) is in this photograph subordinated to a general expression of content and repose of all the faculties. The painting has been purchased for the American Philosophical Society, and will be added to those of the distinguished men which adorn its halls.

It should be added in justice to Mr. Pettit, that since the photograph was taken from which our illustration was made, he has improved his original work very notably, thanks to the suggestions of the relatives and personal friends who have viewed the painting, and to the inspiration due to his realizing the importance of his task. The late Russell Smith has also painted a portrait of Professor Cope which it is understood has been presented to the Academy of Natural Sciences.

The picture which follows is of a plaster bust of Prof. Cope by Mr. Eugène Castello of Philadelphia. It is naturally difficult to do justice to a statue in a half tone print, but it is easy to recognize in this work also the superior result which is obtained when a faithful artist interprets nature for the public. The expression, like that in the painting, is dignified and

1879.



1884

1887

1892

thoughtful. Professor Cope gave five sittings for this bust from Nov., 1896 till January, 1897; and as Mr. Castello says " he assisted in the work of modelling by carefully indicating to me what he considered the characteristic points of his head from the position of an anatomist."

Like Mr. Pettit, Mr. Castello undertook this work "as a study artistically and personally," and found "opportunities of making himself familiar with the expressions of that unique face which have been valuable indeed."

The likenesses of Professor Edward D. Cope on the succeeding pages represent him at various times and probably in various moods during the last eighteen years. They are from photographs taken in the years indicated under the pictures; the earliest (1879) by Shew of San Francisco; those of 1884 and 1892 by W. Curtis Taylor; and that of 1889 by Scholl, both of Philadelphia.

These photographs are not all equally successful as pictures, but they represent the gradual change which has been taking place during the last period of his useful life in the vital force of one of the most persistent workers for science, and in this respect they will be of interest to those who know their subject only by name.

If it be asked why so many representations of Professor Cope are given in this, the first number of his journal issued since his death, the answer is that his temporary successor desires to make this, in so far as it is possible, a memorial number. But inasmuch as it would not be possible in so short a time to present a history worthy of the man and his work, only the superficial parts of such a history to wit: his appearance and the emotions which his death have inspired are here attempted. A proper necrological memoir of such a man cannot be prepared in haste, and should require the same painstaking care which its object bestowed on his investigations, for there is a useful lesson to learn from such a work, although one might judge from a remark which Professor Cope made to the writer a few days before his death that he was indifferent on the subject of a proper history of his life.

Being reminded of a promise he had made to the speaker many years ago to prepare a full autobiography, or notes from which a detailed account of his life could be written, he replied that he had published in a certain journal all that could be needed on the subject. A reference to the indicated publication resulted in finding four or five lines chiefly taken up with the statements of his birth, parentage and marriage. Fortunately for those of us who are proud of the achievements of the scientific man of the United States, the records of his career form part of his country's history. They are therefore carefully preserved and may be consulted by those whose interest or duty it is to use them.—P. F.

Edward Drinker Cope, the Editor-in-Chief and sole proprietor of this journal, died on Monday morning, April 12, 1897, shortly before 8 o'clock.

What this simple announcement means to the world of science we shall only begin to appreciate when the notices of his life in the scientific journals of Europe reach us, for highly as he was honored by some of the leaders of scientific thought in this country there is not so general an appreciation here as abroad of the services he has rendered to Natural History.

Those who were nearest to him, and who witnessed the growth of his own knowledge of a particular subject from the few isolated facts, with which his study began, to the complete development of his monographs, in which the object stood out from the rest of the productions of Nature, can best understand what qualities of the mind raised him to the pre-eminence which he honestly and easily won. These were quick, and accurate powers of observation and discrimination, a marvelous memory embracing the minutest details of what had been done in the same direction before, and tireless perseverance and industry amounting to a complete forgetfulness of self and neglect of mere personal comfort when in quest of accurate data. But the great world of readers and workers did not need this personal knowledge to judge of how he worked. It is scarcely credible that the monument which he has unconsciously reared to himself by his unceasing additions to human knowledge has been created in his short lifetime of fifty-six years, and the larger part of it in the face of difficulties which alone would have crushed any other man.

Nor was "species making" his only or even his chief contribution to the world's knowledge. With his power of instantaneously extracting from the well-filled treasury of his mind that group of facts which he needed, and his systematic inspection of the salient characters of an object, it was as easy for him to designate what was new to science in a mass of material just unpacked as for the ordinary naturalist to indicate the parts which were new to himself. In Cope's case the two were usually synonymous.

But his great and crowning faculty was that of recognizing the significance of each of his brilliant discoveries to the whole structure of science. His keenness in this, the highest manifestation of thought, was incomparable; and though his generalizations were often startling, they were never made rashly, and they have usually secured the acceptance of a steadily increasing body of scientific men.

Nor was it alone in the natural or biological sciences that he left the impress of his thought. Psychical phenomena, which are as far as possible removed from zoology and paleontology, enlisted a large part of his interest. Singularly enough for one who dealt so much in the concrete, his tendency was strongly towards idealism and against materialism.

He possessed definite views on all subjects, from metaphysics to politics, and was hopeful and optimistic in all. No amount of discouragement would prevent him from striving and hoping. He always saw a gleam of promise ahead that things would change, no matter how hopeless they seemed to others.

His power of dissociating his personal feelings from his actions on a given subject was so remarkable as to be almost unique.

This ethical side of his character was not generally understood, though his principles were always frankly announced and rigorously followed. No amount of personal liking or repugnance would change his vote on a question which ought to be decided by the qualifications of an individual or the propriety of a course of action, the sole points considered by him were fitness and justice.

Their most devoted friends were not fairer in estimating the true value of those whom Cope considered his bitterest opponents than he. His views and convictions on all subjects were impersonal, and were raised far above the malarial atmosphere of jealousy and malice.

These lines are traced by one who has been for twenty-five years his intimate friend, as a spontaneous tribute to a great master in science at the moment of his death, and may strike a responsive chord in the hearts of those who enjoyed the privilege of close acquaintance with Edward Drinker Cope.

April 12, 1897. PERSIFOR FRAZER.

EDWARD DRINKER COPE.

Professor Edward Drinker Cope died at his home in Philadelphia, April 12, 1897. He was born in Philadelphia, July 28, 1840. His family belonged to the Society of Friends, and was one of the oldest in the State; his ancestor, Oliver Cope, being one of the associates of William Penn in the establishment of the colony. His grandfather, Thomas Pym Cope, was one of the merchant princes of the city.

He received his early education at the hands of a private tutor and in the Westtown Academy. In these early years he had a great love for nature; soon it grew into an overpowering passion, and he fairly haunted the museum of the Academy of Natural Sciences, and here he began his investigations. We cannot here catalogue the long series of papers—nearly a thousand in number—which followed, but it may be of interest to know that the first one was published when its author was not nineteen years' old, and dealt in a masterly way with the classification of the salamanders.

In 1859 he studied the reptiles in the Smithsonian Institution, returning the next year to Philadelphia to work again for three years in the Academy. Then followed for one year study in Europe; not the study of to-day under the direction of a professor, but study of the specimens in the greater museums from London to Vienna.

Upon his return to America in 1864 he accepted the professorship of "Comparative Zoology and Botany" in Haverford College, where he remained until compelled by ill-health to resign in 1867. It is interesting to look over the Haverford Catalogues of those years and to see how thoroughly his courses were comparative, or what to-day is called morphological; and how little they had in common with the descriptive zoology and the analytical botany then taught in almost every American college.

During these early days his spare moments were devoted to the reptiles, and to the very last these forms held a prominent place in his work. Unlike his American predecessors he realized that there was more in a snake, a lizard or a frog than scales and color pattern; he knew that they had brains and viscera and skeletons, and even before he was twenty-five he had worked out a classification of the Anura, which is still the basis of all subsequent work.

It was this study of the skeleton which fitted him, in 1866, to take up the reptiles found in the marl pits (green sand) of New Jersey, and this was his introduction into the field of Paleontology, in which, for years, even to his death, he stood *facile princeps* in America, if not in the world. From this time on he was primarily a vertebrate paleontologist. At times, it is true, he turned to other fields and studied recent forms. He classified the snakes and lizards of North America; published a masterly synopsis of our frogs and toads, salamanders; he studied the fauna of our caves; he classified the fishes; and his work in each of these lines alone would have given him a reputation which many might envy. They were with him but side issues; he studied the recent forms for the light which they could throw on the forms of the past. And it was just this knowledge of forms both living and fossil—a knowledge which was wonderful in its detail and its accuracy, and even more surprising in the ease with which its minutest points were called forth when needed—it was just this knowledge which placed him as a peer of Huxley and Owen in the paleontological field.

From the New Jersey Dinosaurs he turned next to the Miocene fauna of Maryland and Virginia, and in 1868 he undertook the study of the air-breathing vertebrates of the Ohio Geological Survey. Here his studies showed that labyrinthodons and other huge monsters of the past must be grouped together as a distinct order Stegocephali, a generalization which has obtained world-wide acceptance.

In 1870 began his studies of the wonderful fauna buried in the rocks of our territories west of the Mississippi. Some little was known of these strange forms through the labors of Owen and Leidy, but Cope was in reality to open up a new field. In the year just mentioned he visited the Cretaceous of western Kansas and brought to light the huge reptiles so characteristic of that region. In 1872 the Bad Lands about the head waters of Green River, in Wyoming, were investigated; and in 1873 Colorado was the scene of his labors. Then followed his appointment as Vertebrate Paleontologist of the U. S. Geological and Geographical Survey of the Territories, under the direction of the late Dr. F. V. Hayden; and a year later (1874) the appointment to a similar survey, under the direction of Lieutenant Wheeler, of the lands west of the 100th meridian. Both of these positions were held by Cope continuously until all the surveys were merged in the present organization.

During these years Cope was in the field every summer, and in his investigations he visited and collected in every State and territory west of the Missouri. Not only did he collect himself, but he organized parties at his own expense, which were also almost continuously in the field. As a result he amassed a collection of vertebrate fossils from our western territory probably unequalled in extent and in variety. To this he was constantly adding by purchase from other parts of the world. Another result was an unparalleled series of papers from the pamphlet of three or four pages up to his huge quarto "Tertiary Vertebrates," and what was the more remarkable about this whole series was that the whole of these contributions to science were entirely his own work. He had no patience with the view that it is honest, that it is honorable, to hire others to do intellectual work, and that when payment is made for these services all title to the labor passes. Another characteristic of these same papers lies in this: that whether we have before us a hasty preliminary or a well-matured volume we are not in doubts as to what the author had before him. He at once seized upon the saliant and diagnostic features of his specimen, and described it clearly and intelligibly. There were no slovenly descriptions which might cover a dozen different things, and which might later be invoked in a dispute over a question of priority, and be made to fit the most desirable form.

It is not yet time to summarize all of these geological discoveries, to discuss the attempts to correllate the strata of the West with those of the Old World, to enumerate all the lines of descent worked out; but we may be pardoned if we mention a few, which, at the moment of writing, come to mind as of great interest. Here should be mentioned the reptilian giants Camarasaurus and Clidastes; Anaptomorphus, recently brought into such prominence in connection with Hubrecht's views upon the origin of the Primates; Phenacodus, the central stem of the higher mammals; the classification of the Theromorphous Reptilia, and the recognition of this group as the diverging point of Reptilia and Mammalia. This list might be easily extended almost indefinitely, as will readily be seen when we recollect that Professor Cope described nearly a thousand species of fossil vertebrates, and that, with every description there was an accurate conception of the position and relationships of the form described.

In lines other than paleontological his work was of the greatest value. The purchase, some thirty years ago, of the Hyrtl collection of skeletons of fishes—embracing some six hundred specimens—opened the way for a study of the fish-like vertebrates such as no other man has made. As a result he issued in 1871 a classification of the fishes, based upon structural characters, not on external form, which has been the foundation of all subsequent work in this direction, and which is rapidly replacing the older and more artificial systems of Cuvier and of Günther.

Cope's classification of the fishes is the only one that can be used by the student of paleontology. Besides this central work Cope published numerous papers upon the fresh water fishes of North and South America, and, wherever he touched the subject, he left his mark.

In the Batrachia and the Reptilia his work was of the greatest value. His synopsis of the Batrachia, based as it is on the entire structure of these animals, will long remain a standard for the American student; but in studying this work one must remember that its foundations were laid in its broader features, when the author was but twenty-five years of age. His small pamphlet on the osteology of the Lacertilia is a mine of structural facts, while his studies of the snakes, structural and systematic, cannot be ignored.

In the Invertebrates, Cope did but little; but one must not forget his studies of cave faunæ and his papers on the myriapods.

There was another side to Professor Cope's scientific work, that which dealt with theories of evolution. Professor Cope maintained in his earliest essays that the principle of Natural Selection, the very basis of Darwinism, could not be invoked as a *causa vera* to account for the origin of species and of higher groups. It did not explain the origin of variations, but could only act after variations had been produced to perpetuate and preserve those most advantageous to the organism. The cause of variation must be sought elsewhere, and he rehabilitated for this purpose Lamarck's early principle of the effect of use and disuse of parts. In this way he became the founder of the school of Neo-Lamarckians, in which his efforts were ably seconded by others, notably by Hyatt and Packard. He remained, however, until his death, the foremost advocate and exponent of this distinctively American school of philosophical biology.

His work in this line was not experimental, but rested rather on the evidence presented by fossil forms. In this way he could bring to his support a wealth of facts, accessible to no one else. His mechanical explanations were thoroughly and carefully worked out, and his views, like those expressed in his able paper on the homologies and origin of the types of molar teeth, were so cogently expressed that they made numerous converts to his theories.

This neo-Lamarckian view was first set forth in 1868, and was supported by numerous subsidiary theories advanced then and at later dates. Among them were the theory of "acceleration and retardation," the principle of "exact parallelism" so strikingly exemplified in the Anurous Batrachia, "homologous groups" and "consciousness in evolution." Later he turned to those more difficult evolutionary problems

—the origin of intelligence, the evolution of the ethical side of man, etc.—and expressed his views thereon in a series of essays which have attracted wide attention. These evolutionary essays were collected in a volume issued in 1887 under the title "The Origin of the Fittest." Later still (1896) these essays, together with his later contributions to the theory of descent, were summarized in a volume, "The Primary Factors of Organic Evolution;" a volume which several followers of Weismann have recognized as the ablest expression of anti-Weismannian views.

Scientific organizations the world over have expressed their appreciation of the attainments of Professor Cope. He has been elected an honorary or a corresponding member of many societies. In 1872 he was elected a member of the National Academy of Science; in 1879 the Royal Geological Society of Great Britain bestowed upon him the Bigsby gold medal, in recognition of his labors in the advancement of paleontological knowledge. In 1883 he was elected vice-president of the Biological Section of the American Association for the Advancement of Science, and in 1896 he was elected to the presidency of the same organization. In 1886, at the celebration of the four hundredth anniversary of the foundation of the University of Heidelberg, he received the honorary degree of Doctor of Philosophy, the highest honor the University could bestow. In 1889 he was elected Professor of Geology and Mineralogy in the University of Pennsylvania, and he held this position at the time of his death. He became the owner of THE AMERICAN NATURALIST in 1877, and since that time has been the senior editor of the magazine.

Professor Cope was a man of quick decision and of strong convictions. He did not believe in temporizing or acting from motives of policy. There were with him only two conclusions: a thing was either right or wrong, and when his decision was made, his course was clear. Compromise was foreign to his nature. These facts readily explain many things in his history. Personally he was a delightful companion. Gifted with facility and felicity of speech, and with experiences far beyond the run of the ordinary man, an hour in his presence was an hour not easily to be forgotten. How he enjoyed telling of his adventures and his battles; and if the joke were against him, its narration afforded him the more pleasure. Those who have heard him tell of the purchase of the skin of the long-tailed cat in Oregon will never forget the story.

Then how helpful he was. The treasures of his collection and the greater treasures of his intellect were open freely to all. If it would aid a fellow student or would solve a question, his most valuable specimens, even those as yet undescribed, were freely offered, and their bearings fully explained; a helpfulness often acknowledged by most of his fellow paleontologists in their published papers, and all the more noticeable from its rarity in other quarters.

Another characteristic of Professor Cope was his readiness to admit a mistake or to correct an error when shown the truth. Instances of this are numerous. In the pages of this journal, to cite a single example, he severely criticised the late H. B. Pollard, for his theory that the Batrachia had arisen from the Crossopterygian Ganoids. Scarce a year later he accepted the same view, and advocated it in his later publications.

He was a most indefatigable student, and his capacity for work was astonishing. His house was his workshop, and his collections fairly crowded the family out, so that they had to seek other quarters. Everywhere there were either books or specimens. The cellar was filled with alcoholic collections, the upper floor with skins and skeletons, while the other floors were almost solidly filled with fossils. Some years ago his mammalian fossils passed into the possession of the American Museum of Natural History, in New York City. At the time of his death he was engaged in working up the fossils found in the Port Kennedy bone cave.

Professor Cope was married to Annie, the daughter of Richard Pym, who, with their daughter Julia, now the wife of William H. Collins, Professor of Astronomy in Haverford College, survive him.

J. S. KINGSLEY.

RECENT LITERATURE.

Surface Features, Missouri Geological Survey.—Charles R. Keyes, State Geologist, vol. X, 543 pages with 22 plates and 24 figures.

Clay Deposits, Missouri Geological Survey, Charles R. Keyes, State Geologist, vol. XI, 622 pages with 39 plates and 15 figures.

Volume X, contains a report on the Physical Features of Missouri by C. F. Marbut, one on the Formation of the Quaternary Deposits by J. E. Todd and a Bibliography of Missouri Geology by R. Keyes.

The report on Physical Features is the first work of the kind undertaken by any State Survey with the view of covering the entire commonwealth. The different surface features are described and their origin traced by the application of the principles of physiography.

A broad gently undulating upland plain forms the most conspicuous feature of the surface. It is divisible into the Prairie region and the Ozark region. The former has an elevation ranging from 800 feet along the Mississippi to 1200 feet in the northwestern corner of the state. The Ozark region originates in a centre distinct from the Prairie district of elevation. It forms a large part of southern Missouri and portions of adjoining states with a maximum elevation within the former of 1700 feet.

The upland plain is broken by a number of escarpments formed by outcropping edges of hard strata underlain by softer rock. A number of these escarpments are described and the more pronounced are shown on a sketch map. Between successive escarpments lie platforms or belts each with their peculiar surface features depending on the character of the underlying rocks. The report concludes with an excellent account of the development of the streams, the subject of river meanderings receiving special attention.

In the report on the formation of the Quaternary deposits the author gives the distribution and limits of the surface formations of Missouri. The general character and relations of the several classes are thoroughly described. The quaternary deposits of the state are divided into (1) the Bowlder Drift, (2) the Loess and Gray Loamy Clay, (3) Terrace Deposits, (4) Alluvium. The characteristics of each class are clearly set forth and their limits shown on a sketch map. As the drift does not extend beyond the Missouri river the formations treated in the report lie almost wholly north of that stream. The report concludes with a summary of the quaternary history of Missouri.

The Bibliography of Missouri Geology is very full and complete, the plan being that of a dictionary catalogue or bibliographic index. There are included an author's list, a title index and subject entries and cross references. The advantage of this plan is that it is unnecessary to turn back from one title to another to obtain a full bibliographic reference.

Volume XI, is devoted entirely to a report on the clays of Missouri by H. A. Wheeler. Such thorough and complete treatment of its clays has never been undertaken by any state. The physical and chemical properties of clays receive especially full treatment. Thus considerable space is devoted to the subject of the plasticity, fusibility and shrinkage of clays, one chapter being devoted to each. A microscopic study of the clays was also undertaken with interesting results. A surprising variety of deposits are found throughout the state. Each variety is treated separately and its physical and chemical properties, distribution and adaptability to particular uses described. A chapter that will prove of much practical value is the one devoted to the tests and analyses of clays. Not only are the analyses of Missouri samples given but also a very complete list of analyses of American and foreign clays. The report concludes with a brief working bibliography.

Both volumes are illustrated with many full page half tones and present a fine appearance.—A. G. L.

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General Notes.

PETROGRAPHY.[1]

Petrography of the Bearpaw Mountains, Montana.—A second paper[2] by Weed and Pirsson[3] on the rocks of the Bearpaw Mountains describes several intrusive masses in this mountain group, a leucite-lava from Bearpaw Peak and a series of the dyke rocks occurring so abundantly throughout the region. One of the intrusive masses is just north of Wind Butte. It consists of an augite-syenite composed of ægirite-augite, microperthite and a few accessories, among which is sodalite. At the post-office of Lloyd is an intrusive mass of trachyte, that has altered the argillites through which it cuts. The rock consists of orthoclase phenocrysts in an aggregate of feldspar, hornblende, augite in two generations and biotite in two generations. The Structure of this groundmass is allotriomorphic, hence the rock is as closely allied to the syenite-porphyries as it is to the trachytes. Another intrusion near the trachyte is a nephelite-basalt containing biotite and sodalite. The highest point of the mountains, Bearpaw Peak, is composed of leucite-basalt lavas, breccias and tuffs. In the midst of these rocks is an intercalated flow of leucitite, in which occur phenocrysts of biotite, augite and leucite in a groundmass of the thickly crowded leucites in a glass base. An analysis of the rock gives the following result:

SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2	Cl	P_2O_5	NiO	MnO	BaO	SrO	Total
46.51	11.86	7.59	4.39	4.73	7.41	2.39	8.71	3.55	.83	.04	.80	.04	.22	.50	.16	=99.73

The dykes of the region comprise syenite porphyries, leucite basalts, tinguaites and minettes. The tinguaites are mainly porphyritic rocks, but their phenocrysts are limited to the interiors of the dyke-masses, being absent near the peripheries. A tingauite porphyry from near Wind Butte is composed of aegirite, augite, alkali-feldspars, nepheline, cancrinite and small quantities of apatite, sodalite and fibrous hornblende. The pyroxenes present are made up of cores of an aggregate of colorless augites, surrounded by alternate zones of ægerite and augite. The large sanidine phenocrysts in the rock are surrounded by mantles of ægerine prisms, lying parallel to the banding planes of the feldspars.

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Cf. American Naturalist, 1896, p. 741.

[3] Amer. Jour. Sci., Vol. II, 1896, p. 136 and 188.

This fact, together with the absence of phenocrysts near the peripheries of the dyke indicates to the author that the large feldspars are not of intratelluric origin, but that, on the contrary, they were formed in place. The paper closes with descriptions of a quartz tinguaite-porphyry and several pseudoleucite-sodalite-tinguaites.

Rocks of the Laurentian area north of Montreal.—Adams[4] has examined carefully the geology of the Southern portion of the Archean protaxis of North America that lies in the western portion of the Province of Quebec. The rocks occurring in the area studied belong to the Grenville series and to the Fundamental gneiss. The former are present in a series of bands of alternating gneisses, quarzites, limestones and anorthosites, with occasional bands of pyroxene amphibolites, pyroxene-gneisses, etc. All these rocks have been described[5] in other papers, but not as fully as they are described in this one.

The Rocks of the Leucite Hills.—Kemp[6] describes the Leucite Hills in southwestern Wyoming as the remains of a volcanic crater formed in later Tertiary time. These hills and several of the buttes in their vicinity are composed of flows of what was once a very fluid lava followed by upwellings of a more viscous magma. The rocks of the different flows vary in character. Some are extremely rich in leucite. In others sanidine replaces this mineral, and in specimens obtained from Black Rock butte phenocrysts of augite and olivine are plentiful. The rocks in which leucite is most abundant consist almost exclusively of this mineral and biotite. In the feldspathic rocks the quantity of leucite decreases as the sanidine increases. Augite is also present in these varieties sometimes as inclusions in the sanidine and at other times as large colorless crystals surrounded by rims of biotite. The rock of Pilot Butte, about 22 miles southwestern of the Leucite Hills, consists of large colorless crystals of augite and plates of light brown mica in a groundmass composed of a felt of augite microlites and a few leucites in a glass matrix. It is evidently closely related to the leucite rocks (leucite-phonolites) though mineralogically an augitite.

The Rocks of the Columbretes, Spain.—The rocks forming the little group of islands off the east coast of Spain, known as the Columbretes, are trachytes, trachytic-phonolites, tephritic trachytes, basalts and palagonite tuffs according to Becke.[7] The feldspar of the trachytes is sanidine mixed with a plagioclase rich in calcium. The hornblende is a yellowish-brown basaltic variety with a positive angle *c* v *C*, the only instance of a basaltic hornblende with this orientation. The different phases of the trachyte vary in composition as noted below and in structure. The basalts and tuffs present no unusual features. The rocks offer a good illustration of a petrographical province, the basalts representing the most basic members and the phonolites the most acid ones. The tephritic trachytes, with their small percentage of leucite are intermediate rocks. Analyses of the phonolitic (I) and the tephritic (II) trachytes and of the basalt (III) follows:

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[4] Geological Survey of Canada. Ann. Rep., Vol. VIII. Pt. J.

[5] American Naturalist. 1897, p. 564, 1896, p. 300 and 579.

[6] Bull. Geol. Soc. Amer., Vol. 8, 1897, p. 169.

[7] Min u. Petrog. Mitth., XVI, p. 157 and 308.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	P_2O_5	SO_3	CO_2	Cl	Total
I.	55.93	.42	21.83	3.62	.34	.61	2.54	7.84	6.01	.72	.22	.08	.03	.51	= 101.17
II.	53.12	.25	20.48	5.13	1.50	1.88	4.29	6.20	4.88	2.25	.43	.14		.28	= 100.59
III.	47.54	tr	17.70	5.19	6.20	5.94	9.12	4.01	1.43	.72	.62	tr	.10	.07	= 98.64

The chemical relations of these rocks to one another are represented graphically by means of a triangle whose angles represent 100 per cent. each of Na, Ca and K. The discussion upon which this method of representation is based cannot be entered upon in this place.

The dykes associated with the tonalite of Meran in the Tyrol.—Grubenmann[8] gives brief descriptions of the dyke rocks connected with the tonalites near Meran. These are quartz-mica porphrites, tonalite-porphyrites, tonalite-pegmatites, diabases and hornblende-kersantites. The pegmatites consist of plagioclase, microcline, quartz and muscovite. Where in contact with gneiss, this rock has developed in it andalusite and garnet.

Petrographical Notes.—The correctness of the analyses of the granular rock of Rongstock in the Bohemian Mittelgebirge having been called into question by Lang a new analysis has been recent published by Hibsch.[9] The results of this confirm the analysis first published.

Lyons[10] has analyzed a large number of specimens of the soils originating from the decomposition of Hawaiian lavas, and a series of the lavas from which they were derived. The results show that in the incipient weathering of the lavas there is a loss of silica, titanic acid, manganese, soda, potash and copper. The quantity of calcium present remains unchanged, while the percentage of magnesia increases. Upon further alteration magnesium, calcium and phosphoric acid are almost

[8] Ib., XVI, p. 185.

[9] Ib., XV, p. 487.

[10] Amer. Jour. Sci., Vol. II, 1896, p. 421.

completely lost. In the soils, however, there is a larger proportion of calcium and potassium present than in the 'rotted' lavas. This increase is ascribed to the action of plants and animals.

In an article in the Ponza Islands Schneider[11] describes the geological, relation of the rhyolites, the trachytes, the pitchstones and the tuffs of the first two named rocks occurring there. His conclusions are questioned by Sabatini.[12]

BOTANY.[13]

New Species of Fungi from Various Localities.—(Continued from p. 343.)—HYPOXYLON VERNICOSUM E. & E. On dead wood. Sent from Ohio by Mr. A. P. Morgan as *Hypoxylon marginatum* (Schw.).

Stroma flattish-pulvinate, 2–3 x 1 cm. and 3–4 mm. thick, black and varnished outside and the uneven surface pitted all over by the papilliform ostiola, surrounded by an annular depression as in *H. marginatum.* Perithecia cylindrical, extending down nearly to the bottom of the stroma and about ⅓ mm. diam. Asci cylindrical, 75–80 x 4μ, short stipitate, 8-spored. Sporidia oblong-elliptical, 6–7 x 3–3½μ. Differs from *H. marginatum* (Schw.) in its varnished stroma and cylindrical perithecia.

PEZIZA (HUMARIA) TRACHYDERMA E. & E. On decaying wood partly buried in the soil, Valentine, Nebraska, May, 1896 (Rev. J. M. Bates, No. 416).

Sessile, shallow cup-shaped, 2–4 mm. diam., carnose, thinning to the acute, spreading margin, wood color when fresh, the furfuraceo-verrucose exterior remaining so when dry, but the hymenium becoming nearly liver color. Margin spreading when fresh, narrowly involute when dry. Asci cylindrical, 200 x 12–14μ, truncate above. Paraphyses thickened at the lips. Sporidia uniseriate, oblong-elliptical hyaline, smooth, 14–18 x 10–12μ.

Resembles somewhat a diminutive *Peziza vesiculosa*, but more open and shallower.

PHIALEA ARENICOLA E. & E. On sandy ground near "Blackbird Landing Bridge," Delaware, June, 1896 (Commons, No. 2784).

Stipitate, concave, becoming plane or even slightly convex, disk dull orange, 2–3 mm. broad, outside lighter, uneven, subpruiose. Stipe stout, 2–4 mm. long, substriate, gradually enlarged above, same color as the disk. Asci narrow, linear, straight, short-stipitate, 60–65 x 4μ, paraphysate, 8-spored. Sporidia sub-biseriate, oblong, hyaline, continuous, 6–8 x 1½μ.

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[11] Min. u. Petrog. Mitth., XVI, p. 65.

[12] Ib., p. 530.

[13] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

Differs from *P. epigaea* Karst. in its larger ascoma and much smaller sporidia.

TRICHOPEZIZA COARCTATA E. & E. On dead branches of *Vaccinium myrtilloides*, Mountains, Skamania Co., Wash., July, 1894 (Suksdorf, No. 507).

Scattered, superficial, sessile, hemispheric cup-shaped, smoky-white, 300–400μ diam., thin membranaceous, margin contracted quite strongly at first, so as to leave only a small, round opening, and fringed with short, fasciculate, smooth hairs about 25 or 30 x 2–2½μ. Asci clavate-oblong, 30–35 x 5–6μ. Sporidia biseriate, ovate, hyaline, 2-nucleate, 4–5½ x 2½–3μ.

Closely allied to *T. confusa* Sacc. (*T. punctiformis* Rehm.), but differs in its longer asci and different character of the hairs.

SCLERODERRIS ABIETINA E. & E. On bleached bark of fir trees, Newfoundland, September, 1896 (Waghorne, No. 61).

Erumpent-superficial, black, obconical, about ½ mm. diam., hymenium discoid or convex, areolate, with a very narrow, thin, almost obsolete margin. Asci clavate-oblong, sessile, rounded above, 70 x 15μ, 8-spored, overtopped by the filiform paraphyses. Sporidia fasciculate, clavate-cylindrical, multinucleate, becoming multiseptate, 50–65 x 3–4μ, hyaline.

HOLWAYA TILIACEA E. & E. On bark of dead *Tilia*, Canada (Macoun).

Ascomata gregarious or solitary, subcupulate, expanding to plane, thin (when dry), margin subundulate, 2–4 mm. across, black, with a short, thick stipe. Asci cylindrical, short-stipitate, 120–150 x 7–8μ. Paraphyses? Sporidia fasciculate or subbiseriate, narrow fusoid-cylindrical, nearly straight, multinucleate, hyaline, 40–62 x 3–3½μ.

Closely resembles outwardly *Bulgaria inquinans*. *Coryne ellisii* Berk. (*Stilbum magnum* Pk.) is found with this, and may be its conidial stage.

UROMYCES ROSICOLA E. & E. On leaves of *Rosa fendleri?* Crawford, Nebraska, June, 1896 (Rev. J. M. Bates, No. 438).

III. Sori hypophyllous, chestnut-brown, confluent over the entire lower face of the leaves, at first covered by the epidermis, soon naked. Spores globose or obovate, 20–35μ in the longer diam., epispore thick and coarsely tuberculose. Pedicels stout, about as long as the spores.

PUCCINIA SPHAERALCEAE E. & E. I and III. On *Sphaeralcea angustifolia,* Mesilla, New Mexico (Prof. T. D. A. Cockerell).

I. *Aecidium sphaeralceae* E. & E., Bull. Torr. Bot. Club, August, 1895, p. 364.

III. Sori hypophyllous, minute, arranged in a circle, 2–4 mm. across, confluent, at first covered by the epidermis and pale chestnut color, soon naked and dark chestnut color. Teleutospores elliptical or oblong-elliptical, 30–35 x 19–22μ, nearly hyaline at first, becoming pale brown, slightly constricted at the septum, mostly regularly rounded and only slightly thickened at the apex, mostly also rounded below but often slightly narrowed at the base; epispore smooth. Pedicels stout, persistent, reaching 150μ long, hyaline.

Differs from *P. malvacearum* Mont. in the presence of an *Aecidium,* in its smaller, more obtuse and comparatively shorter teleutospores.

AECIDIUM SCLEROTHECIOIDES E. & E. On leaves of *Senecio lugens*? Golden, Colorado, May, 1896 (E. Bethel, No. 5).

Pseudoperidia amphigenous, subepidermal, buried in the substance of the leaf in pale yellowish, slightly swollen orbicular spots 2–4 mm. diam., slightly prominent in pustules ½ mm. across, at first closed, then irregularly open at the apex revealing the mass of reddish-brown spores which are globose 20–27μ, ovate 20–27 x 15μ, or subangular from compression; epispore smooth or nearly so, rather thick.

Differs from *A. sclerothecium* Speg. in its smaller, inseparable pseudoperidia.

PHYLLOSTICTA HEUCHERAE E. & E. On leaves of *Heuchera cylindrica* near Lake Waha, Idaho, June, 1896 (A. A. & E. G. Heller, No. 3265).

Perithecia amphigenous, hemispherical, suberumpent, broadly perforated above, 110μ diam., crowded in orbicular patches, ½–1 cm. diam. Sporules abundant, cylindrical, hyaline, 5–6 x 1–1¼μ.

Probably the spermoginal stage of some dothideaceous fungus.

ASTEROMA IVAECOLUM E. & E. On stems of *Iva xanthiifolia,* Denver, Colorado, September, 1896, E. Bethel, No. 28).

Fibrils feather-like, appressed, radiating, forming dark brown spots 2–3 cm. across. Perithecia seated on and among the fibrils, depressed-hemispherical 110–130μ diam., perforated above. Sporules oblong, hyaline, 4–6 x 1½–2μ.

SPHAEROPSIS CELTIDIS E. & E. On dead limbs of *Celtis occidentalis,* Phillips Co., Kansas, 1896 (Bartholomew, No. 2348).

Perithecia gregarious or scattered, subseriate, about ⅓ mm. diam., covered by the epidermis which is slightly raised and barely pierced by the conic-tuberculiform ostiolum. Sporules oblong-elliptical, brown, 18–21 x 8–10μ.

SPHAEROPSIS PHLEI E. & E. On bulbous base of dead culms of *Phleum pratense*, Newfield, N. J., December, 1896.

Perithecia densely gregarious, erumpent-superficial, black, ovate, about ¼ mm. diam., with a papilliform or sometimes conical ostiolum. Sporules oblong-elliptical, brown, 18–22 x 7–10μ.

PHLYCTAENA ALBOCINCTA E. & E. On dead stems of *Rhus toxicodendron radicans*, Newfield, N. J., September, 1896.

Perithecia buried in the bark, 400–700μ diam., the short ostiolum barely perforating the epidermis. Sporules linear, curved, narrowed and curved above, 12–15 x 1–1½μ. A horizontal section shows the perithecia surrounded by a white ring.

SCHIZOTHYRELLA BOREALIS Ell. & Sacc. On dry, decorticated (beech)? wood, Potsdam, N. Y., June, 1896.

Perithecia superficial, scattered or subseriate, orbicular or elliptical, ⅓–½ mm. diam., ovate-globose, at first with a papilliform ostiolum, soon broadly open and cup-shaped, glabrous, black. Sporules cylindrical, hyaline, occasionally dichotomous, separating into segments 6–15 x 1½–2μ, 1–3 septate.

Differs from *S. australis* Speg. in the dehiscence of the perithecia (not laciniate) and the shorter narrower sporules.

CYLINDROSPORIUM SPIRAEICOLUM E. & E. On leaves of *Spiraea betulifolia*, near Lake Waha, Idaho, June, 1896 (A. A. & E. G. Heller, No. 3303).

Acervuli innate, on small, light yellow, irregularly shaped spots 1–2 mm. diam., few (1–7) on a spot. Conidia clavate-cylindrical, straight, rounded and obtuse above, gradually attenuated below, 3–5 septate, 40–70 x 3½–5μ, hyaline, erumpent above in orange-yellow masses.

Differs from *C. filipendulae* Thüm. in its epiphyllous acervuli and larger clavate conidia.

MARSONIA CALIFORNICA E. & E. On leaves of *Juglans californica*, Santa Monica, California, August, 1896 (Prof. A. J. McClatchie).

Spots amphigenous, angular, 1–3 mm. diam., subconfluent, ferruginous becoming grayish above, border narrow, slightly raised, dark. Acervuli innate, visible on both sides of the leaf. Conidia cylindrical, mostly straight, but sometimes slightly curved, hyaline, uniseptate, 20–27 x 3μ, obtusely rounded at the ends.

Differs from *M. juglandis* (Lib.) in its smaller, definite spots and cylindrical conidia.

ASTRODOCHIUM E. & E., nov. gen.

Sporodochia innate-superficial, formed by the transformation of brown, appressed, branched, radiating fibers. Conidia oblong, continuous, hyaline, borne singly and terminal on simple basidia.

Astrodochium coloradense E. & E. On fallen leaves of *Quercus undulata*, Morrison, Colo., December, 1896 (E. Bethel, No. 170).

Epiphyllous, forming round brown spots ½–1 cm. across and having the general aspect of *Asteroma*. The adnate fibers abundantly and sub-oppositely branched towards their extremities are soon transformed into round or elliptical, subdiscoid, light amber-colored sporodochia ¼–½ mm. diam. consisting of closely packed obclavate, 12 x 2½μ, hyaline basidia bearing at their tips the oblong hyaline, 4–6 x 1¼–1½μ, conidia.

Belongs in Fam. *Tubercularieae*, *Mucedineae.*

Sepedonium tuberculiferum E. & E. Parasitic on *Peziza hemisphaerica* Wigg. and *P. fusicarpa* Ger., Nuttallburg, W. Va., July, 1896; alt. 1800 ft. (L. W. Nuttall, No. 883).

Hyphae effused, forming a thin, white layer on the surface of the hymenium, becoming pulverulent and yellowish at maturity; fertile hyphae with the ultimate divisions di-trichotomously or verticillately branched, the branches lanceolate, 20–30 x 2–2½μ, bearing at their extremities the globose conidia 15–18μ diam., bearing at symmetrical distances on their periphery 8–10 depressed globose, hyaline smooth tubercles 6–7μ diam. and sometimes separable from the central spore.

Torula erumpens E. & E. On decorticated, weather-beaten wood (poplar)? Morrison, Colo., December, 1896 (E. Bethel, No. 166).

Erumpent in flat, discoid, orbicular or elliptical tufts ½–¾ mm. diam. Conidia cylindrical, 2–5 septate, concatenate, 10–20 x 3½–4μ, dark brown, nearly opaque.

Macrosporium fici Ell. & Kelsey. On leaves of *Ficus elastica*, Oberlin, Ohio, September, 1896 (Prof. F. D. Kelsey, No. 1076).

Hyphae amphigenous, very dark brown, fasciculate, septate and more or less constricted at the septa, 70–125 x 4–5μ forming olivaceous tufts as large as a small pin's head thickly scattered over the large (1–2 cm.), dirty white spots with a dull purplish-red border. Conidia club-shaped, 3–7 septate, with a more or less complete longitudinal septum, 40–50 x 10–16μ, with a pedicel 20–30μ long.

Quite different from *M. torulosum* Pass. on limbs of *Ficus*.

J. B. Ellis and B. M. Everhart.

Botanical Notelets.—Dr. R. E. Call publishes, in the Journal of the Cincinnati Society of Natural History (March, 1897), an interesting note on the Flora of Mammoth Cave, Kentucky. The species observed are all fungi, as follows, viz.: *Coprinus micaceus, Fomes applanatus, Rhizomorpha molinaris, Microascus longirostris, Zasmidium cellare, Mucor mucedo, Gymnoascus setosus, Sporotrichum flavissimum, Laboulbenia subterranea, Coemansia* sp., *Papulospora* sp., *Bouderia* sp. and *Peziza* sp.

The Annual Report of the State Botanist of the State of New York, for 1894, just issued, is of more than usual interest, since it contains a comprehensive paper on the "Edible and Poisonous Fungi of New York," illustrated by 43 colored plates. Included in the report is a paper by Dr. E. C. Howe on the "New York Species of Carex," in which one hundred and thirty-three species are described at length.

The Report of the Botanical Department of the New Jersey Experiment Station for the year 1896 indicates that Dr. Halsted has been very industrious in his studies of fungicides. The many half-tone reproductions of photographs add much to its value.

Mr. F. L. Stevens has reprinted from the Journal of the Columbus (Ohio) Horticultural Society (Vol. XI, No. 4) a convenient reference index to Dr. Halsted's bulletins and reports on plant diseases. It will be very serviceable to botanists and horticulturists. The same writer published, in the journal cited, an account of the parasitic fungi on Ohio Weeds. Some of these have proved very destructive to their hosts.

Ascherson's "Synopsis des Mitteleuropäischen Flora," of which parts 1 and 2 have been received, promises to be interesting and useful, but its use will be greatly lessened by the failure of the author to properly indicate the authority for each species. The sequence of families in these parts is as follows, viz.: *Hymenophyllaceae, Polypodiaceae, Osmundaceae, Ophioglossaceae, Salviniaceae, Marsiliaceae, Equisetaceae, Lycopodiaceae, Selaginaceae.*

Recent Changes in the Nomenclature of North American Trees.—In looking over the pages of Sudworth's "Nomenclature of the Arborescent Flora of the United States," the writer noted the following changes which are not yet generally found in manuals and lists of species, and which it may be well to reprint here for the benefit of those who do not have access to the most recent literature. It is not thought necessary to repeat the list of hickories (*Hicoria* spp. formerly *Carya* spp.), since the changes in nomenclature which they have undergone are now well-known to every tyro. Nor is it necessary to repeat *Toxylon* (*Maclura*), since it is eighty years since this name was proposed (1817). In the following list the name accepted by Sudworth appears first, while the name which is still commonly used in the manuals is placed within brackets.

Pinus radiata Don., Monterey Pine (*P. insignis* Dougl.).

Pinus attenuata Lemmon, Knobcone Pine (*P. tuberculata* Gordon).

Pinus virginiana Mill., Scrub Pine (*P. inops* Solander).

Pinus echinata Mill., Shortleaf Pine (*P. mitis* Michx.).

Pinus divaricata (Ait.) Gordon, Jack Pine (*P. banksiana* Lambert).

Picea canadensis (Mill.) B. S. P., White Spruce (*P. alba* Link.).

Pseudotsuga taxifolia (Poir.) Britton, Douglas Spruce (*P. douglasii* Link.).

Sequoia washingtoniana (Winsl.) Sudworth, Bigtree (*S. gigantea* Decaisne).

Chamaecyparis thyoides (L.) B. S. P., White Cedar (*C. sphaeroidea* Spach).

Chamaecyparis nootkatensis (Lamb.) Spach, Yellow Cedar (*C. nutkaensis* Spach).

Chamaecyparis lawsoniana (Murr.) Parl., Port Orford Cedar (*Cupressus lawsoniana* Murr.).

Tumion taxifolium (Arn.) Greene, Florida Torreya (*Torreya taxifolia* Arnott).

Tumion californicum (Torr.) Greene, California Torreya (*Torreya californica* Torr.).

Hicoria laciniosa (Michx. f.) Sargent, Shellbark Hickory (*H. sulcata* (Willd.) Britton.

Salix fluviatilis Nutt., Sandbar Willow (*S. longifolia* Muehl.).

Salix bebbiana Sargent, Bebb Willow (*S. rostrata* Rich.).

Populus deltoides Marsh., Cottonwood (*P. monilifera* Aiton).

Fagus latifolia (Muenchh.) Loudon, Beech (*F. ferruginea* Aiton).

Castanea dentata (Marsh.) Borkh., Chestnut (*C. vesca americana* Michx.).

Quercus minor (Marsh.) Sargent, Post Oak (*Q. obtusiloba* Michx.).

Quercus plantanoides (Lam.) Sudworth, Swamp White Oak (*Q. bicolor* Willd.).

Quercus virginiana Mill., Live Oak (*Q. virens* Aiton).

Quercus velutina Lam., Yellow Oak (*Q. tinctoria* Bartram).

Quercus digitata (Marsh.) Sudworth, Spanish Oak (*Q. falcata* Michx.).

Quercus pumila (Marsh.) Sudworth, Bear Oak (*Q. ilicifolia* Wang.).

Quercus marilandica Muenchh., Black Jack (*Q. nigra* Wang.).

Quercus nigra L., Water Oak (*Q. aquatica* Walter).

Quercus brevifolia (Lam.) Sargent, Blue Jack (*Q. cinerea* Michx.).

Ulmus pubescens Walter, Slippery Elm (*U. fulva* Michx.).

Sassafras sassafras (L.) Karst., Sassafras (*S. officinale* Nees.).

Gymnocladus dioicus (L.) Koch, Kentucky Coffee-tree (*G. canadensis* Lam.).

Cotinus cotinoides (Nutt.) Britton, American Smoke-tree (*Rhus cotinoides* (Nutt.) T. & G.

Rhus hirta (L.) Sudworth, Staghorn Sumach (*R. typhina* L.).

Rhus vernix L., Poison Sumach (*R. venenata* DC.).

Acer saccharum Marsh., Sugar Maple (*A. saccharinum* Wang.).

Acer saccharinum L., Silver Maple (*A. dasycarpum* Ehrhart).

Acer negundo L., Box Elder (*Negundo aceroides* Moench.).

Acer negundo californicum (T. & G.) Sargent, Californian Box Elder (*Negundo californicum* T. & G.).

Nyssa sylvatica Marsh., Black Gum (*N. multiflora* Wang.).

Nyssa ogeche Marsh., Sour Gum (*N. capitata* Walter).

Nyssa aquatica L. Tupelo Gum (*N. uniflora* Wang.).

Mohrodendron carolinum (L.) Britton, Silverbell-tree (*Halesia tetraptera* Ellis).

Mohrodendron dipterum (Ellis) Britton, Snowdrop-tree (*Halesia diptera* Ellis).

Fraxinus nigra Marsh., Black Ash (*F. sambucifolia* Lamarck.).

Fraxinus pennsylvanica Marsh., Red Ash (*F. pubescens* Lamarck.).

Fraxinus lanceolata Borkh., Green Ash (*F. viridis* Michx. f.).

Catalpa catalpa (L.) Karsten, Common Catalpa (*C. bignonioides* Walter).—CHARLES E. BESSEY.

Note on Lysimachia nummularia L.—This plant is found escaped from cultivation near Decatur, Ill. It started from a cemetery, where it is cultivated, and now runs wild over an unused part of the cemetery, and for a distance of half a mile along a little stream running from it. The seeds float down and extend its habitat every year. When it once takes root it drives out all other vegetation except *Nepeta glechoma* and a few tall plants as *Lobelia syphilitica, Impatiens pallida*, etc. It spreads very rapidly, rooting at every node and forming long parallel stems, three to five feet long, making a matted growth. When not in flower it resembles, at a distance, *Nepeta glechoma.* It blooms from June to August. It is often called "wild myrtle."—ALLAN GLEASON, *Secy. Agassiz Asso., Chapter 56.*

Another Popular Botany.—In a pretty little book by Mrs. Dana—"Plants and their Children"—we have an illustration of the mixture of fact and fancy which the children of the near future are destined to read and pore over in their " Nature Study." The author well says, in her preface: "A child's reading book, it seems to me, should secure for the child three things—practice in the art of reading, amusement and instruction." She has certainly secured the first and second of these objects, and not a little of the third. Had she taken counsel of some good botanist her book might have been more instructive and less misleading. Her description of the bean (on page 81) and her figure 88 are either absolutely incorrect, or, at the least, quite misleading. Similarly misleading is figure 119, the mistletoe (by which the author means the American mistletoe), for it illustrates not the American plant (*Phoradendron*) with which the child is supposed to be familiar, but the Europen (*Viscum*). Figure 136, which is said to show " a seed cut across, and so magnified that you can plainly see its many cells," is a reduced copy of a figure in plate 80 in Grew's Anatomy of Plants, published in 1682! We can not blame old Nehemiah Grew for making such an inaccurate drawing: we may rather give him some praise for doing so well when we consider his tools and environment, but certainly an author must be severely censured who, more than two hundred years later, reproduces it without saying a word as to its incorrectness.

While much of the text is good, some of it is as bad as the cuts we have mentioned. The plant physiology is sometimes ridiculous, often worse. The chapter on " How a Plant's Food is Cooked," is particularly bad. What can we say of a sentence like this: " When the watery broth [in the leaves] is cooked in the sun, the heat of the sun's rays causes the water to pass off through the little leaf-mouths!" Or of this: " There is a tree, called the *Eucalyptus*, whose leaves perspire so freely that it is planted in swampy places in order to drain away the water!"

Mrs. Dana writes so fluently that what she writes is likely to be read with pleasure, and it is her duty to attend much more carefully to her facts. This book must be revised before it can be commended as a reading book for children.—CHARLES E. BESSEY.

VEGETABLE PHYSIOLOGY.

Ecological Plant Geography.[1]—Plant geography can be considered from two standpoints. First, floristic plant geography, which treats of the flora of a region, a list of the species growing within certain geographical limits, the relative proportion of certain species, the relation of an insular flora to that of the mainland, or of a mountain flora to that of the adjacent valleys; that is, facts concerning distribution. Secondly, ecological plant geography, which treats of plant communities as resultants of all the forces working upon them.

The ordinary observer has no difficulty in noting that the plants over one area are different from those over another. He distinguishes the swamp, the meadow, the scrub, the pine-barren, the prairie, and other equally well-marked plant communities. What he notices, however, may not be that certain species of plants grow in one area and certain other species in another, it is rather the general appearance of the area, that is, its *physiognomy*. It is not a difficult matter to determine the species which are associated to form a certain plant community with its corresponding physiognomy. A more difficult question to answer is, however, "Why do these species unite into certain communities, and why have they the physiognomy which they possess?"

It is the task of the author in the 382 pages of the book before us to solve these questions. The author lays down a few general principles, some of which I cannot refrain from giving. "Every species must conform, both in inner and outer structure, to the natural conditions under which it lives, and if, when those change, it cannot adapt itself to them, it will be crowded out by other species, or become entirely eliminated. It is, therefore, one of the first and most important problems of ecological plant geography to understand the *epharmosis* [die Epharmonie, l'epharmonie] of the species, or what can be called its life-form [Lebensform]. This is shown especially in the configuration of the plant and in the duration of the [so-called] organs of assimilation (in the structure of the leaf and of the entire sprout, in the life period of the individual, etc.), and to a less degree in the reproductive organs. This problem leads one far into morphological, anatomical and physiological studies; it is very difficult, but very attractive. It cannot be entirely and satisfactorily solved, but much can be done in the future.

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[1] *Lehrbuch der Oekologischen Pflanzengeographie.* Dr. Eugenius Warming. Translated from the Danish by Dr. Emil Knoblauch, 1896, Berlin, Gebrüder. Borntræger.

"What increases the difficulty of the problem is, for example, the fact that besides the conforming power of many external factors, and besides the adaption of species to these factors, there are innate, hereditary dispositions, that from inner unknown causes produce structures which we cannot bring into any relation to the surrounding natural conditions, at all events not to those present, and which we cannot therefore understand. These inner dispositions, different according to the natural relationship, bring along with them this, that the development of the species under the influence of the same factors can lead to the same result in entirely different ways. While, for example, one species adapts itself to a dry habitat by means of a thick coating of hair, another species under the same conditions cannot bring forth a single hair, but choses, for example, to cover itself with a layer of wax, or to reduce its foliage and become a stem-succulent, or becomes ephemeral in its development." This paragraph explains fairly well the scope of the problem which the author endeavors to solve.

The term "Lebensform" is further explained. The cactuses, fleshy euphorbias and the succulent stapelias, though belonging to widely different families all possess the same life-form.

In a certain area or habitat, certain species have adapted themselves to the conditions there present, and so form a plant community (Pflanzenverein). Of course these plant communities cannot always be sharply divided, and the same species may occur in more than one community. But, nevertheless, each community possesses its peculiar physiognomy.

"Ecological plant geography must deal with the following:

"1. The factors of the outside world that play a rôle in the economy of plants, and the action of these factors upon the external and internal structure of plants, upon the life-period and other ecological relations, as well as upon the topographical limits of the species.

"2. Grouping and characterizing of the classes of communities (Vereinklassen) present upon the surface of the earth.

"3. The conflict between the communities."

The first section of the work deals with the ecological factors. The atmospheric factors are light, heat, moisture and air currents. The terrestrial factors are composition and physical condition of the soil, air and water in the soil, and other physical characters; the effect of dead or living mantle (snow or fallen leaves) upon the surface, of animals (earth-worms, moles, etc.), or plants (fungi, bacteria) beneath the surface of the soil, and finally, the effect of the direction and height of mountain chains, angle and direction of slope, and similar considerations.

But plants must adapt themselves not only to the physical conditions mentioned, but also to animals and to other plants. Man is far from an insignificant factor. The interdependence of plants and animals, such as flowers and pollinating insects, plants and ants, etc., though not discussed at length, plays a more or less important part in the battle.

The greatest struggle, however, is that which takes place between the plants themselves. A more or less stable equilibrium has been established in several ways. Parasitism, helotism (applied by the author to the relation of organisms in the lichen thallus), mutualism (root tubercles, etc.), epiphytes, with all their curious adaptations, saprophytes, lianas, are carefully considered. Over a given area where the various factors are comparatively constant, certain species are found which have adapted themselves to these conditions and to each other. These together make the plant community and present to the eye a certain physiognomy. Two plant communities living under similar conditions may present similar physiognomies, but may consist of widely different series of species. With the exception of subglacial and desert regions there is a conflict among individuals, those inherently less hardy and those accidentally unfavorably placed being first to succumb.

Hence, we have a kind of association known as commensalism. This term is sometimes used in the sense of mutualism (symbiosis); but, as used by the author, it means rather an established equilibrium between individuals struggling for the same food. It is to be noted that the strife between individuals of the same species is much greater than that between individuals of different species, since, for example, they may use different materials in the soil.

The first 120 pages of the work is taken up with preliminary discussions, as briefly outlined. The author gives a classification of the various plant communities. They are grouped in four classes, depending upon the relations of these to water. "The regulation of transpiration of plants appears to be the factor which influences most profoundly the forms of plants, and which imprints upon them most markedly their external characters. If the evaporation is greater than the water supply, the plant wilts, and this influences the most important life processes, even if it does not go so far that death results."

The classes are as follows:

"I. HYDROPHYTE-VEGETATION.—This is an extreme vegetation whose plants are either wholly, or, for the most part, surrounded by water, or grow in soil well filled with water (the per cent. of water amounts to probably more than 80).

"II. The Xerophyte-vegetation is the opposite extreme, whose plants grow upon stony soil, or, at least, during a greater portion of the year, in soil scarcely supplied with water, and in dry air. The water content can, indeed, if it is at a minimum amount, be less than 10 per cent.

"III. The Halophyte-vegetation is closely related morphologically to the foregoing, but merits a separate consideration, an opinion that is confirmed, among others, by the investigations of Stahl. It is a very extreme vegetation, that is limited to salty soil and whose morphological peculiarities appear likewise to be caused by the regulation of evaporation.

"IV. The Mesophyte-vegetation includes the communities that are adopted to a soil and air of medium moisture, and to a soil also which is not particularly salty. The plants form a morphological and anatomical standpoint, are not especially extreme in their characters."

Space will not allow even an outline of the interesting chapters following, but for illustration we will glance at the xerophytes.

In the xerophytes adaptation has taken place along two lines, reduction of the transpiration during the critical period, and a development of especial means for gathering or storing water. Regulation of transpiration may be accomplished by reducing the evaporation in the following ways: 1. Periodical reduction of evaporating surface; deciduous trees dispense with their leaves in winter, bulbous plants relinquish the exposed parts in the dry season, annual plants pass this season in the seed stage; the leaves, especially of grasses or the thallus, may roll up in various ways. 2. The leaves change their position so as to regulate the amount of light, and consequently the amount of heat which they receive from the sun; many *Leguminosæ* place their leaflets in a vertical position during the heat of the day (para-heliotropism). Even our much-despised purslane shows this on a hot day; the common impression being that it is wilting—it knows better than that. 3. A permanent vertical position of the foliage organs. If the leaves are upright they tend to throw their surface into a meridional plane (compass plants). The leaves may be directed outwardly and twisted on their petioles (*Eucalyptus*), or hang on slender petioles (cotton-wood). The petioles may be laterally flattened and take the function of foliage (many *Acaciæ*). 4. The surface may be reduced in proportion to the volume, such as the needle-like leaves of the pine, the succulent leaves of the sedums, or where the stem acts as foliage and the leaves are reduced to scales, as in the cactus or asparagus. 5. The evaporation may be hindered by a coating of hairs, a common contrivance in dry regions, giving usually a gray color to the physiognomy. The hairs must be dead and filled with air. 6. Anatomical structure. The epidermis may be cutinized, or encrusted with various substances; the stomata may be sunken or otherwise protected. The contrivances for this purpose are legion. 7. The author calls attention to the frequent presence of etherial oils in xerophytes, and, though the use is not clear, suggests that the leaf becomes coated with a layer of the vapor of this volatile oil; and, since this layer is much less diathermous than air, the evaporation is lessened.

Under adaptations for absorbing water may be mentioned certain glandular hairs of desert plants and air-roots of epiphytic orchids. Some kinds of glandular hairs secrete hygroscopic salts, such as calcium chloride, which readily absorb water. "Volkens thinks that the plants take up water in this way. Marloth, however, regards this salt coat only as a covering to hinder transpiration, and even thinks that the plants thus free themselves from a part of the salts taken up."

Under storage of water we have various kinds of water tissue, succulent plants with sap which does not readily part with its water, and fleshy underground parts.

An outline of the xerophite classes may be of interest.

"A. Rock vegetation, that of the subglacial and temperate regions: that of dry tropics.

"B. Subglacial vegetation upon loose earth. Stony plains sparsely beset with plants, due often to lack of warmth rather than lack of moisture; moss heaths; lichen heaths.

"C. Dwarf-shrub heaths (mostly *Ericaceæ*).

"D. Sand vegetation, Strand flora, discussed more at length under Halophytes; vegetation of shifting dunes; vegetation of permanent dunes; sandy scrubs and timbered barrens.

"E. Tropical deserts.

"F. Xerophilous, herbaceous vegetation. Steppes and prairies; savannahs.

"G. Stony heaths (Felsenheiden) such as the Asiatic steppes covered with thorny shrubs.

"H. Xerophilous scrubs (Gebüsche). In arctic and temperate regions; in Alpine regions; tropical thorn-, palm-, fern-, bamboo-scrubs, etc.

"I. Xerophilous forests. Evergreen conifers; deciduous conifers; xerophilous, deciduous forests; leafless forests (*Casuarina*)."

The other three primary divisions are discussed in a similarly thorough manner. Swamp plants frequently possess xerophilous characters. Many suggestions are made to explain this, such as: in regions of high latitude or altitude, xerophilous characters lessen evaporation early in the season, when the roots are inactive, due to cold soil; or the activity of the roots is hindered by the difficulty of aeration, hence the need of lessened evaporation; or, again, since the stomata remaining open, cannot regulate evaporation, xerophilous characters are necessary.

The most probable explanation of the presence of xerophilous characters in halophytes is that the roots have difficulty in obtaining water from the strong solution of salts in which they are placed, hence the necessity of lessened evaporation.

The closing section treats of the struggle between the various plant communities.

The book should be read by every student of ecology; but more, the general reader would be amply repaid by its perusal. It is to be hoped that the book may be translated into English.*—A. S. HITCHCOCK.

ZOOLOGY.

The Gas of the Natatory Vessels of Physalia and of Fishes.[1]—As a result of a search[2] for argon in the natatory vessels of *Physalia* and of fishes there were found in the vessel of the former (*Physalia pelagica* Lk) from 85–91 per cent. of nitrogen, and from 9–15 per cent. of oxygen, but no other gas. In the swimming bladder of surface fish (*Polyprion cernium* Val.) there was found about 80 per cent. of nitrogen, 18 per cent. of oxygen, and 2 per cent. of carbonic acid gas, while in deep sea forms, such as *Murœna helena*, taken from a depth of 88 meters, and *Synaphobranchus pinnatus* Gr., taken from a depth of 1385 meters, 3–6 per cent. of carbonic acid gas and oxygen in the large amount of 73–85 per cent. were found.

The Genus Ascaris.—In his monographic work[3] devoted to this genus of worms, Stossich considers 218 species. Of this number 35 occur in mammals, 47 in birds, 29 in reptiles, 5 in amphibians, 98 in fishes, 1 in an insect, and 1 in an unknown host. 117 of the lot, are doubtful forms. The remaining 101 Stossich divides into groups: (1) those with a dentated fold and no median lip; (2) those with both dentated fold and a median lip; (3) those with the median lip but not the dentated fold; and (4) those with three simple lips. 32 of the lot are larval forms mostly from fishes.

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*An English translation of this book is now in preparation and will be published by Macmillan.—ED.

[1] Richard A. (96). Sur les gas de la vessie natatoire des poissons et des physalies. Bull. Mus. Hist. Nat., Paris, 41–3.

[2] Schloesing, Th., and Richard J. (96). Recherche de l'organ dans les gas de la vessie natatoire des poissons et des physalies. Compt. Rend. Ac. P., CXXII, 615–7.

Zool. Centralbl., IV, 19.

[3] Bull. Soc. Adriat. Sc. Nat., Trieste, XVII (1896), pp. 7–120. Zool. Centralbl., IV (1897), p. 20.

The Excretory Organs and the Blood-Vascular System of Tetrastema græcense Böhmig.[4]—The small fresh-water nemertine that was first discovered by Böhmig in 1892 has since then been found in sufficient numbers to enable its discoverer to give a brief description of the excreto-genital and the vascular systems. The former is easily recognized in compressed animals, and appears as a system of coiled and anastomosing tubes along each side for the whole length of the animal. The tubes of opposite sides do not unite, although their very close contact sometimes causes them to seem to do so. At the anterior end of the animal near the brain there is only one canal, which is large, coiled, and looped, and ends finally in a meshwork-like system of smaller canals. Nothing like it appears at the opposite end of the animal. Into the larger, as well as into the smaller canals, empty numerous fine canals, which arise from the end-organs.

In the organs, he distinguishes three portions: (1) the terminal canals, (2) the connecting canals, and (3) the end organs. The first lie mostly between the external muscle layer and the intestine, and are formed by cells unprovided with cilia. They connect with the excretory pores, of which there may or may not be an equal number on each side of the animal. In one case there were 5 pores to a side; in another, 6 on one, and 3 on the other side.

The connecting canals are distinguishable from the others by their greater thickness and the nature of their bordening cells, which bear cilia. The rounded, superficially smooth end-organs are provided at their free ends with two (seldom only one) flame cells, and seem to be formed by 3–5 cells resembling those of the terminal canals in appearance. In general it may be said that they communicate with the terminal canals only through the mediumship of the connecting canals. Yet, a direct connection between the two has been seen.

The vascular system consists of 3 branches, 2 lateral vessels, and a dorsal vessel. Near the brain the last communicates with the right lateral vessel, and posteriorly with both the right and left vessels through an anal commissure. The walls of the vessels are formed of (1) an inner endothelial, (2) a circular muscular layer, and (3) an outer layer of mesenchymal cells arranged like an epithelium. Between the endothelial and the muscular layers are large cells of a hemispherical form and peculiar structure, which, at the moment of diastole, stand out from the wall of the vessel, and at the time of systole plunge into it. They appear to guide the flow of the blood.

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[4] Böhmig (97). Vorläufige Mittheilung über die Excretionsorgane und das Blutgefässystem von *Tetrastema græcense* Böhmig. Zool. Anz., XX, 33–6.

A connection between the nephridia and the vascular system, such as Berger has described for marine nemertines, especiallly for *Drepanophorus*, does not occur.

The Existence of Epitokic Forms in the Annelid Family Cirratulidæ.[5]—Two members of this family, namely, *Dodecacerca concharum* Örst. (=*Heterocirrus ater* Qfg.) and *Heterocirrus flavoviridis* St. Jas. have been found in an epitokic stage, which differs from that of certain of the Licoridæ and Syllidæ: (1) in the possession of very long swimming processes in the dorsal branch of the parapodia, (2) in having two highly developed eyes on the cephalic lobe, (3) in the shortness of the feeler of the first segment, (4) in the slightly spatula-form of the end of the body, (5) in the irregular coloring, (6) in a different musculature, and (7) in the possession of mature sexual products. The individuals are of different sexes. In August atokic and epitokic forms as well as connecting forms are found side by side.

A Study of the Form of the Crop of the Libellulidæ and their Larvæ.[6]—Recently a number of anatomical observations made by the author cited, on the form of the crop, the distribution of the "teeth," etc., in the same, have been made use of for systematic and phylogenetic purposes. A series of the larvæ and imagines of the genera, *Calopteryx*, *Agrion*, *Pyrrhosoma*, *Erythromma*, *Enallagma*, *Ishnura*, *Platycnemis*, *Lestes*, *Gomphus*, *Æschna*, *Anax*, *Corduligaster*, *Diplax*, *Libellula*, *Epophthalmia*, *Cordulia*, and *Orthetrum*, were studied, and as a result the conclusion arrived at that the crop of Colopteryginæ represents the primitive form. This shows sixteen areas irregularly covered with teeth. A perfection of this form appears in the Agrioninæ, in which there is a greater supply and a more regular arrangement of the teeth. In the case of the genus *Lestes* there are but eight longitudinal folds, a number that in the gomphininæ and æschninæ is reduced to four. While the *Condulegaster* show a striking concentration of the armature, which is limited to two pairs of teeth. In fact, the original radially symmetrical arrangement is seen to have been transformed to a bilateral one. The structures are best studied in the larvæ, for they become considerably reduced and obscured in the imago. Summarizing his results in the form of a phylogenetic tree the author considers the agrioninæ and the petalurinæ to have arisen from the primitive form, calopteryginæ. Then from the petalurinæ there arose three branches, two of them terminated by the æschninæ and the gomphinæ respectively; the third passed off to one side as a low branch that formed the cordulegastrinæ. From this form there arose one branch that soon divided and finally gave rise to the corduliinæ and the Libellulinæ, the highest of the dragon-flies. The author's conclusions differ from those of Calvert in that the cordulegastrinæ form a link between the two forms represented by the subfamilies corduliinæ and Libellulinæ, and that represented by the petularinæ, instead of an independent branch.

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[5] Mesnil, F., and Caulbry, M. Compt. Rend. Ac. Sc. Paris, 1896.

[6] F. Ris. Untersuchung über die Gestalt des Kaumagens bei den Libellen und ihren Larven. Zool. Jahrb. Abth. Syst., IX (1896), 596–624.

The Regeneration of an Antenna-like Structure Instead of an Eye.—The regeneration of a structure very much resembling that animals antennula on the stump of an eye stalk of *Sicyonia sculpta* is well worth recording along with the regeneration of a well-formed lens from the iris in *Triton*, as described by Wolff and also by Müller whose paper was noted in the NATURALIST some time ago (p. 72).

The regeneration of such a structure is described by C. Herbst[7] in several out of eighty-five specimens from which he cut the eye. Only six of the eighty-five remained alive at the end of five months after the operation, but all but one of these showed evidence of a regenerated structure. Some seven other cases were secured during the five months by fixing the animals recently dead, or about to die, so that he had twelve good cases showing a regenerated structure. Similar experiments had previously been performed upon the eye stalk of *Palæmon*, with like results.

The accompanying figures represent the three groups into which Herbst divides the regenerated structures according to their degree of perfection. In the first (fig. 1) there is shown only a small protuberance (*n*) having little evidence of segmentation. In the second group (fig. 2) there is developed a large process provided with two hairy areas and a secondary two-jointed lobe that Herbst likens to a crustacean flagellum (*fr*). In the third group (fig. 3) a large antenna-like structure is developed, having, like the last structure, two hairy areas (which do not normally occur on the eye stalk), and, in addition, two several jointed processes. This last figure scarcely needs the detailed argument that Herbst devotes to it to prove that it is antenna-like, and to show that the endopodite (*en*), exopodite (*ex*) and protopodite (*pr*) are represented.

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[7] C. Herbst. Festschrift der Naturf. Gesel. Zurich, 1896, pp. 435–54.

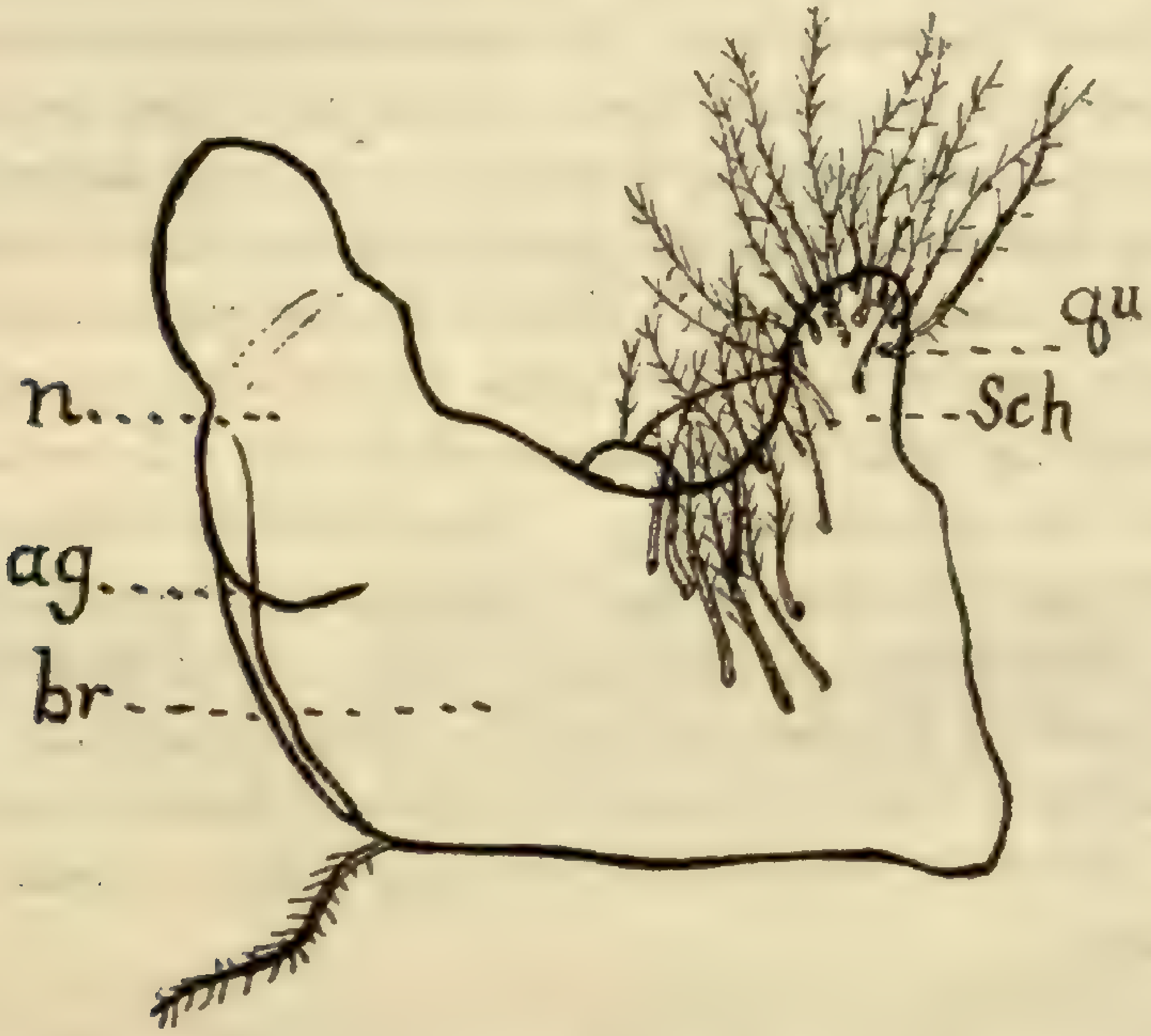

Fig. 1.

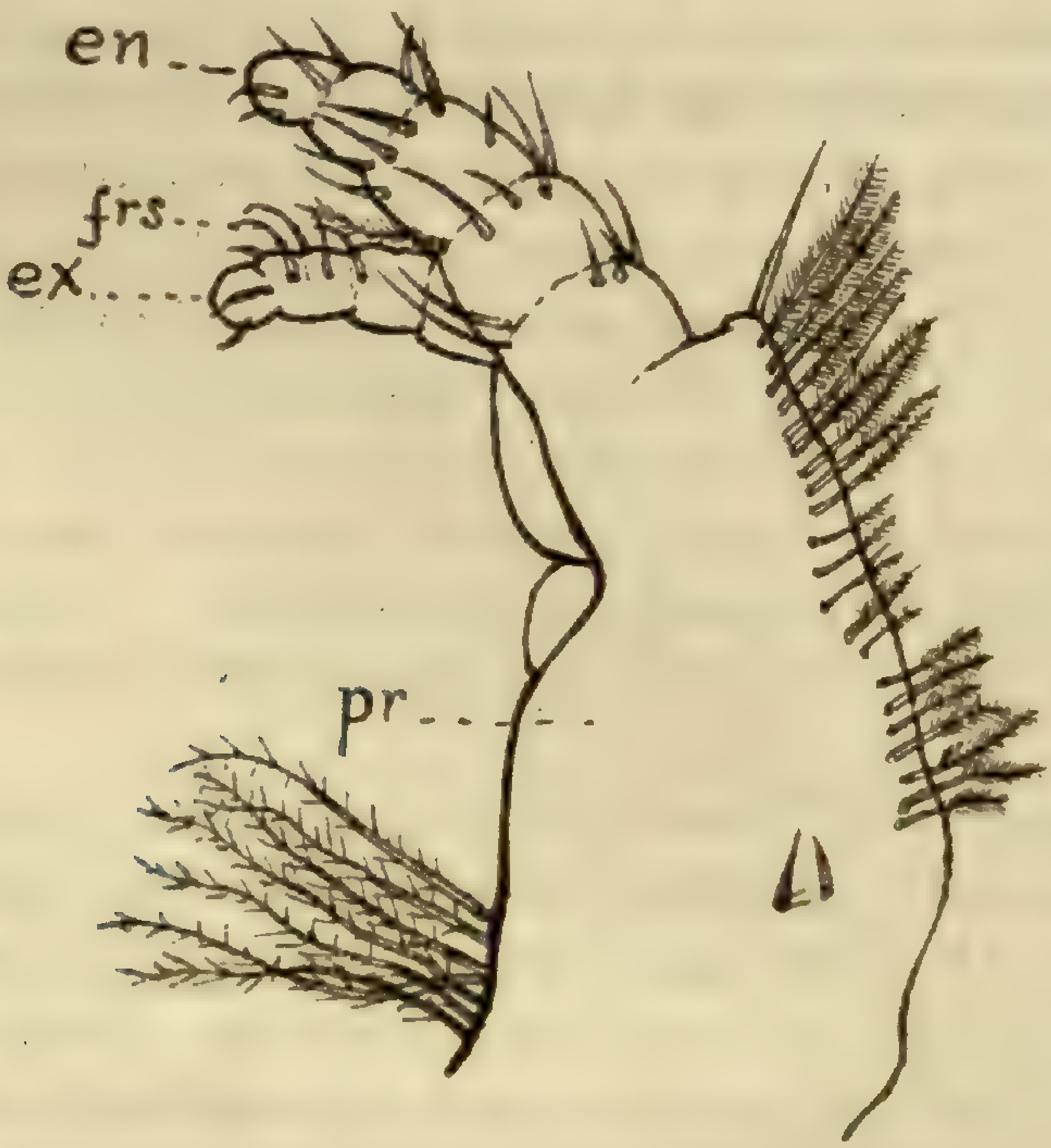

Fig. 2.

The occurrence in crustacea of an antenna-like organ in the place of an eye was noted as early as 1864 by Milne-Edwards[8] in the lobster, *Palinurus penicillatus,* and later (1894) by Hofer[9] in *Astacus.* To ask what bearing these cases and the results of Herbst's experiments have upon the general question of arthopod segmentation is but to repeat the query made by Milne-Edwards. He thought that he had found new evidence of the truth of Savigny's law. Later, writers have not generally considered the eye or optic stalk as the homalogue of a segmental appendage, nor have they considered the protecerebral lobe, from which the eye is innervated, as evidence of a segment. It may be a hasty conclusion, but the cases of an antenna-like structure certainly seem to indicate that Milne-Edwards was right, and that one may in the future be obliged to consider the arthopod head as having one more segment in it than we have till now supposed it to have. Further experimentation is necessary to show what internal structures are regenerated, for Herbst seems to have made no sections whatever of the structures that he describes. One would like to know to just what extent the muscles are developed, and what happens to the stump of the optic nerve. Experiments should also be made to determine what, if

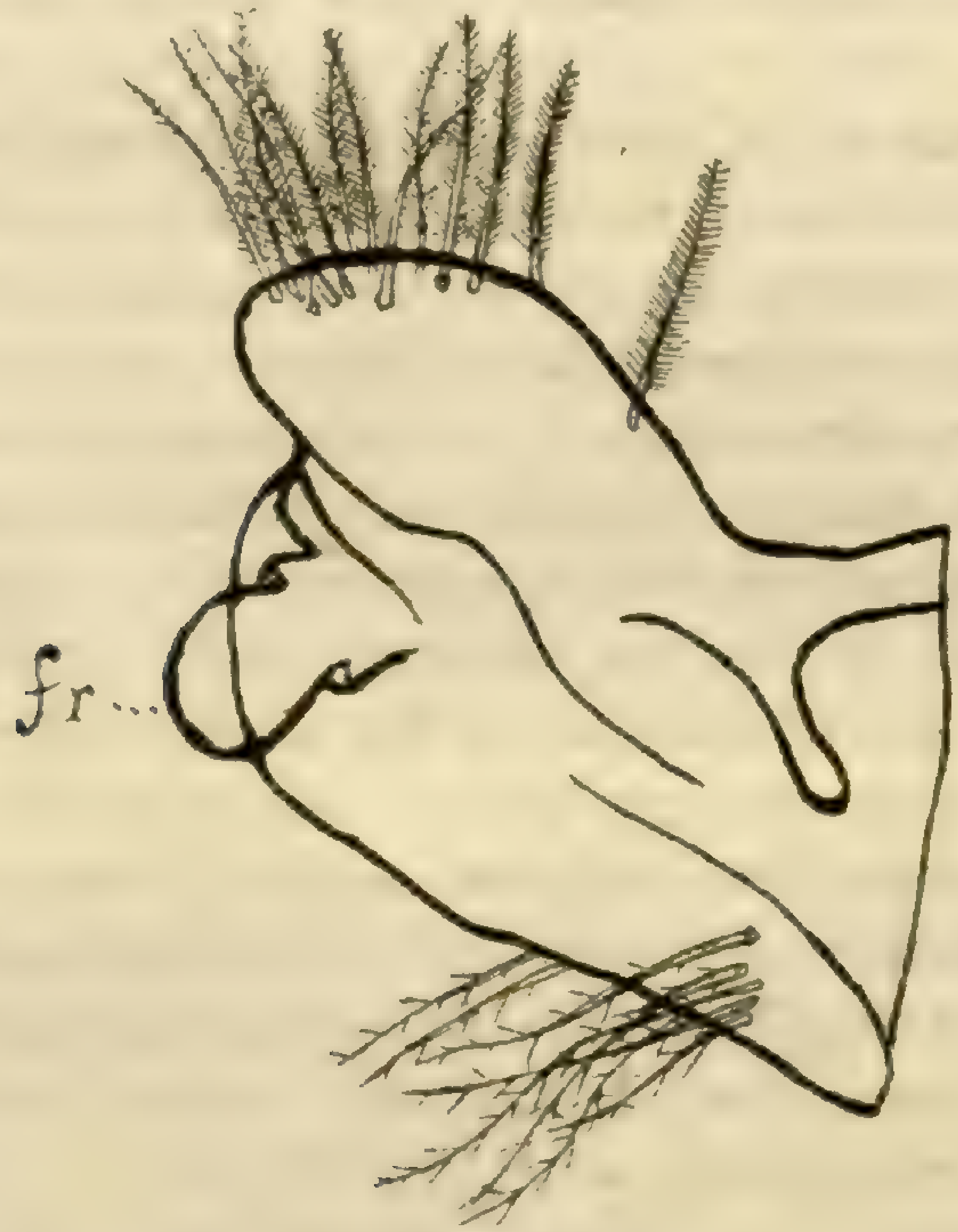

Fig. 3.

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[8] Hofer. Ein Krebs mit einer Extremität statt eines Stielauges. Verh. d. Deutsch. Zool. Gesel., 1894.

[9] A. Milne-Edwards. Comp. Rend. Acad. Sci. Paris (1864) LIX, pp. 710–12.

any, differences are to be noted when the stalk is cut through at different distances from the eye so as to leave intact different portions of the optic ganglia.—F. C. KENYON.

Variability of External Sutures in the Skull of Chelone mydas L.—In a paper entitled Bemerkungen über die Systematische Stellung von Dermochelys Blainb.,[10] Baur quotes from Boulanger, as follows:

"The lower border of the post-frontal joins the jugal and the squamosal, and cantrary to what exists in the Cheloniidæ is separated from the quadrato-jugal by the two latter bones." Baur then adds that he finds the same relation in two specimens of *Chelone mydas* L.

I have before me three skulls of *Chelone mydas* L. from the Atlantic coast, one from an animal weighing about thirty pounds, and two of quite precisely the same size from specimens which weighed from sixty to seventy pounds. In the first, or small skull, I find the squamoso-jugal separation, as well as in one of the larger skulls. In the third there is a distinct squamoso-jugal union. Internally the skulls all agree. Further differences in these skulls are slight. There is apparently no order for the junction right and left of parietals and frontals, and frontals and parietals. These, with the squamoso-jugal union or non-union should be recognized as altogether variant characters in the osteology of *Chelone mydas* L.—GEO. R. WIELAND.

Lists of Mammals of Raleigh, N. C.—The following list of the mammals found near Raleigh, N. C., is based on twelve years of mammal collecting in this vicinity, and observations made since 1880 on the mammals of this locality by my brother and myself. We have preserved some 1,500 or 2,000 specimens as skins, or alcoholics, besides catching in our trapping a number of others which were not preserved. A number of specimens have been bought from the farm hands employed in ploughing, or cutting hay, thus adding considerably to our knowledge of several species, notably *Zapus hudsonius*. The country lying immediately southeast of Raleigh, where most of the collecting was done, is mostly rolling country, except along Walnut Creek, where there are considerable tracts of wet meadow and some good sized cat-tail swamps. The drier portion of the country collected over is about one-half cultivated, and the other half woodland.

The commoner mammals are distributed as follows: *Sciurus carolinensis* and *Sciuropterus volans* in woods, the third arboreal species, *Pero-*

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[10] Biologische Centralblatt, Dec., 1889, Erlangen.

myscus aureolus, being an inhabitant of damp thickets. *Lepus sylvaticus*, *Peromyscus leucopus*, *Blarina carolinensis* and *Scalops aquaticus* are found nearly everywhere in woods and fields both, except in the more watery situations, where only aquatic species occur; *Microtus pinetorum* is found in the drier woods and fields; *Sigmodon hispidus* in the drier fields, but not in woods. *Mus musculus*, *Reithrodontomys lecontei*, *Blarina parva* and *Microtus pennsylvanicus* occur in open fields and the edges of the marshes, the last species penetrating the marshes much farther than the others. *Oryzomys palustris*, *Fiber zibethicus*, *Lutreola lutreocephalus* and *Lutra hudsonica* are all more or less aquatic, being found mainly or entirely along streams, or in the wet marshes. Of the bats, *Vesperugo carolinensis* is the common bat of the low grounds, and *Atalapha borealis* of the uplands.

The species observed here, are as follows:

1. *Didelphis virginianus.* Opossum. Tolerably common. I once took a litter of fourteen young ones, August 4, 1891.

2. *Lepus sylvaticus.* Cotton-tail Rabbit. Common. The young of this species are blind at birth.

3. *Mus alexandrinus.* Roof Rat. The long-tailed, white-bellied Roof Rat is common here, around houses and farm buildings, but is not found away from such places (*Mus decumanus* and *Mus rattus* I have never observed at Raleigh).

4. *Mus musculus.* House Mouse. Common in houses, and irregularly distributed throughout all open fields.

5. *Sigmodon hispidus.* Cotton Rat. Abundant in the upland fields, particularly in gardens and in grain and clover fields. By far the most diurnal in its habits of any of our mice.

6. *Peromyscus aureolus.* Golden Mouse. Common in damp thickets. Nests in reeds, bushes or vines. Our only arboreal mouse.

7. *Peromyscus leucopus.* White-footed Mouse. Abundant everywhere, except in the wet marshes. Nests in the rotten roots of old stumps below ground, or in hollows of dead stumps above ground.

8. *Oryzomys palustris.* Tolerably common in the wet marshes and cat-tail swamps. The nest is built in a bush or bulrush tussock often fifty yards from land.

9. *Reithrodontomys lecontei.* Harvest Mouse. Abundant in the open fields and on the edges of marshes, but is not found in woodlands. The few nests I have found have been in bulrush tussocks in rather damp situations.

10. *Microtus pinetorum.* Pine Mouse. Fairly common, found in the drier parts of woods and fields, and is more subterranean in its habits

than any other of our mice, and also, I think, more so than any of our Shrews.

11. *Microtus pennsylvanicus.* Meadow Mouse. Found to a greater or less extent in all open fields, but reaches its greatest abundance in the wet meadows, where its habitat overlaps that of *Oryzomys.* It is not found in the woodlands.

12. *Fiber zibethicus.* Musk Rat. Common in marshes and along the larger streams. A black color phase or variety occurs which is black above with lighter under-parts and cheeks than the common form. The black form is one-fourth or one-third as common as the ordinary brown phase.

13. *Scurius carolinensis.* Southern Gray Squirrel. Tolerably common in all woodlands (Although I have made very careful inquiries I have been unable to find any evidence that the Fox Squirrel ever occurred here).

14. *Sciuropterus volans.* Flying Squirrel. Common. Strictly nocturnal.

15. *Tamias striatus.* Chipmunk. They are fairly common about six miles west of Raleigh, but are totally absent from my immediate neighborhood.

16. *Zapus hudsonius.* Jumping Mouse. Rare. The one or two dozen specimens we have secured here come from upland, lowland, woods and open fields. An adult female and eight young were caught in a nest by some field hands, and brought to me, June 13, 1895.

17. *Sorex longirostris.* Rare. Only seven specimens obtained so far. This species is found on comparatively high ground, not in swamps nor on the edges of them ; it has not so far been taken in woods, though one specimen was caught just on the edge of some woods. This is the smallest of our mammalia.

18. *Blarina parva.* Little Blarina. Tolerably common. Is either only abundant in particular situations, or else it has become much scarcer in the last few years. Is found in open fields (and the edges of the more upland marshes to some extent).

19. *Blarina carolinensis.* Carolina Blarina. Abundant. This species I believe to have become more abundant of late years ; its distribution here is the same as that of *Peromyscus leucopus,* namely, everywhere, except in the wetter marshes, where *Oryzomys palustris* and *Microtus pennsylvanicus* are the only small mammals.

20. *Scalops aquaticus.* Common Mole. Abundant everywhere.

21. *Vespertilio lucifugus.* Little Brown Bat. Rare. Only two specimens so far.

22. *Lasionycteris noctivagans.* The Silver Black Bat is rather rare here. I have several times had specimens brought to me in winter that were captured in hollow trees.

23. *Vesperugo carolinensis.* This and the Red Bat are our two most abundant bats. Very common.

24. *Adelonycteris fusca.* Large Brown Bat. Rare. Only about a dozen specimens taken.

25. *Nycticejus humeralis.* The Twilight Bat is fairly common here, but never occurs in half the numbers of the Red Bat, or *Vesperugo carolinensis.*

26. *Atalapha borealis.* Red Bat. Abundant. This bat flies later in the autumn and earlier in the spring than any other of our bats. The number of young at birth is usually three, while in *Vesperugo carolinensis* and *Nycticejus crepuscularis* two is the normal number.

27. *Lutra hudsonica.* Otter. Occurs on all the larger streams. My brother, H. H. Brimley, has caught eight specimens at various times.

28. *Mephitis* (*sp*). A Skunk was killed near Raleigh a few years ago, the only one we ever heard of.

29. *Lutreola vison lutreocephalus.* Southern Mink. Common along water-courses. The females (and sometimes the males) are not infrequently brought to me as "Weasels."

30. *Putorius noveboracensis.* Weasel. One male caught by my brother, when trapping, January 13, 1888. I have heard of others, but have never been successful in getting them.

31. *Procyon lotor.* Raccoon. Quite rare in the immediate vicinity of Raleigh.

32. *Urocyon cinereo-argentatus.* Grey Fox. Not infrequently caught by fox-hunters in this vicinity. The Red Fox is said to occur in adjoining counties.—C. S. Brimley.

ENTOMOLOGY.[1]

Insects Affecting Domestic Animals.—In the last issue of the new series of Bulletins of the U. S. Division of Entomology (No. 5), Prof. Herbert Osborn devotes nearly 300 pages to a treatment of this subject. The bulletin is an important and extremely useful one, with 170 illustrations. In the introduction there is a general discussion of parasitism from which we extract the following regarding the origin and results of parasitism. The problems of the origin of parasites, or the adaptation of certain forms to a parasitic life, are among the most interesting met with in biological investigation, but we can suggest merely some of them here.

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[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

It may be said from the biological standpoint that all parasites have been derived primarily from non-parasitic forms—a proposition which is supported by innumerable facts in their morphology and embryology, and which may also be argued deductively. Since many species are confined absolutely to certain animals as hosts, it is evident that they could not have existed as parasites upon such species at least before the occurrence of the host. Unless, therefore, we claim an independent origin for them subsequent to the origin of the host we must allow an adaptation from some free-living species or from a parasitic species on some other host, and following this back for its origin, we must ultimately arrive at a free form as the source.

In many cases the line of evolution is very apparent, as, for instance, the gradation between comparatively free and fixed Mallophaga, Acaridæ, Pulicidæ, etc.

RESULTS OF PARASITISM.

It is also interesting to inquire as to the effect of the parasitic life upon the parasite itself.

The natural tendency of an animal once started in the direction of parasitism will be to become more and more parasitic in habit, and with this habit a greater and greater specialization of parts with reference to this habit will be observed. The disuse of certain organs, as wings for flight and feet for ordinary locomotion, results in reduction or modification of these organs, and hence we find almost invariably that parasitic species are wingless, and that they have the feet adapted specially for locomotion among the hairs or feathers of the hosts. This adaptation is often looked upon as degradation ; but it seems to me preferable to consider it as a limitation in certain directions with specialization of certain organs. We consider the foot of the horse highly specialized, and we must admit that the animal is limited in its use, as it cannot climb trees, but we do not call the horse degraded.

It is true that the limitations for many parasites are so great that they are absolutely dependent upon certain hosts, and the presence of certain conditions for their existence—there is reduction or degradation of certain organs, but progressive specialization of those organs which remain functional. Often such specialization assumes a parallel character in widely divergent groups, as the clasping organs developed in pediculids, mallophagids, hippoboscids, and sarcoptids. In other cases the same effect is attained by a different process, as the flattening of the body vertically in fleas and horizontally in most other permanent parasites. Modifications of the mouth-parts, eyes, and antennæ are very great, and furnish most striking examples of the modification of structures for the adaptation to special conditions.

Life-History of Coleophora malivorella.—In an admirable Bulletin (124 of Cornell Experiment Station), Mr. M. V. Slingerland discusses the Pistol Case-bearer, summarizing its life-history thus: The insect spends about seven months (from September 1st to April 1st) of its life in hibernation as a minute, half-grown caterpillar in a small pistol-shaped case attached to a twig. In the spring the caterpillars attack the swelling buds, the expanding leaves, and especially the flowers. About May 1st the cases are fastened to the twigs, where they remain for four days, during which time the caterpillars shed their skin or moult. They do not make any complete new suit as they grow, but are content with making additions to the ends and side of the old suit. They are not miners, but feed openly, eating irregular holes in the leaves, often skeletonizing them. They are most destructive on the flowers, where they eat the petals and stems. In the latter part of May they cease feeding, securely fasten the cases to the branches, and in about two weeks change to pupæ within. The moth emerges in two or three weeks, and soon glues its minute, pretty, cinnamon-colored, inverted cup-like eggs to the surfaces of the leaves. The egg-stage lasts about a week, the little caterpillar emerging about July 22d. They begin eating little holes in the leaves, and during their first meal construct of silk and excrement a small case or suit for themselves. They continue feeding on the leaves, adding to their suits from time to time, until about September 1st, when they begin to migrate to the twigs, and there fasten their little pistol-shaped cases to the bark. The winter is passed in these snug, warm, secure quarters.

Studies of Mimicry.—Col. C. Swinhoe, after studying and thinking over the general theory of protective mimicry, conceived that the subject should be advanced by the study of a small group of widespread mimetic species throughout the different countries included in its range. While the Bolina group of Hypolimnas contains according to systematists a number of species, they can all be merged into two, and it was these that he selected for his purpose. He describes in detail the appearances of these widely spread forms, and comes to the conclusion that the facts afford the strongest support to the theory of mimicry as originally suggested by H. W. Bates; a variety of changes which occur are explained by this theory and by no other yet propounded. Local changes may be explained in many ways; but that they should invariably be in the direction of a superficial resemblance to one butterfly, and that one a specially defined species, is only to be explained by the theory of mimicry. Although much support has been afforded to this theory since Bates propounded it in 1862, Col. Swinhoe states that no evidence is so complete and convincing as that supplied by the genus Hypolimnas. If we are right in believing that the results are determined by the range and abundance of mimetic forms, it is clear that selection, rather than unguided variation, is the essential cause of the phenomena.—*Journ. Royal Microscop. Society.*

Remarkable Vitality.—Early in September, 1896 I collected two forms of life from Great Salt Lake, one was the brine shrimp *Artemia fertilis,* the other the larva of a fly, the *Ephydra gracilis.*

After keeping these in salt water for ten days I washed them in fresh water, and then placed them in a small vial *filled* with a 3 per cent. solution of formaline.

After they had been in this solution for ten days I had occasion to examine them, and on taking them from the vial I found that thiee of the Ephydras were still living and active. The vitality of the Ephydra seems to be fully equaled by the vitality of the *Stenophelmatus fasciatus* order Orthoptera. Some fragments of this insect were sent to the University of Utah for identification. Among the fragments was the prothorax bearing the head. This piece lived for nine days, and during that time when ever it was irritated would attempt to bite with its powerful jaws. It would also turn over into its natural position when placed on its back.—C. A. WHITING.

EMBRYOLOGY.[1]

Two animals from one egg.—To the many known cases in which two animals may be obtained from one egg by experimental interference, may now be added the amphibian *Triton cristatus.* By the aid of a simple piece of apparatus Amedeo Herlitzka[2] succeeded in isolating the first two cells of the egg and ultimately obtained from each cell a perfect, symmetrical, free-swimming larva.

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[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Archiv f. Entwicklungsmechanik. IV, März 2, 1897, pps. 624–654, pl. 27.

Contrary to what has often been stated for the result of similar experiments upon other animals these larvæ are not half the normal size, though each arises from half an egg.

Each larva is larger than half a normal larva. There are also certain remarkable facts concerning the size of the organs and the number of cells in these half-egg larvæ. Thus while the intestine and the muscle segments appear on transverse section much smaller than in the normal larva, the medulla and the notochord are *equal* in transverse section to the normal. In the medulla and in the muscle segments the nuclei have the same size in the half-egg larvæ as in the whole egg larvæ.

The number of cells seen in cross section is half as great in the muscle segments of the half-egg larva while the number of cells in the medulla is the *same* in the half-egg larva as in the whole-egg larva!

It seems that certain structures may be formed with less than the normal number of cells while others have the normal number.

Do the Astral Rays pull or push?—Ludwig Rhumbler[3] concludes that the radiations often seen as star-like figures during cell division are probably lines of pulling or drawing and not lines of extension or pushing. He thinks the only adequate explanation of cell division is one based upon Bütschlis' theory of the foam-like structure of protoplasm and in deciding in favor of a contractile rather than an expansive action along the astral rays he thinks he brings support to the foam theory of protoplasm.

In a previous paper[4] he began the first of a series of attempts to explain cell division upon a physical basis; he assumed a vesicular or foam-like structure for protoplasm and also certain chemical changes in the centrosomes leading to periods of great absorbtion of liquid. The withdrawal of liquid from the vesicles round about leads to tensions and, if rapid enough, to the appearance of radiating lines of vesicles. Based then chiefly upon phenomena of surface tension in the constitutent vesicles of protoplasm, each a viscid bag with more liquid contents, this hypothesis seeks to reduce all the complexities of cell division to a very few physical laws.

The present paper gives a few noteworthy figures of sections of snail's eggs showing a marked vacuolated or vesicular appearance in the protoplasm around the centrosome and also representing the astral radiations not as mere lines but as flat ribbons or plates. In the author's mind this means that the rays are not muscle-like fibrils, but the fused walls of alveoli or vesicles—hence their flat appearance.

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[3] Archiv f. Entwicklungsmechanik. IV, März 2, 1897, pps. 659–725. Pl. 28.

[4] See AMERICAN NATURALIST for January, 1897, p. 84–6.

The main part of the paper is taken up with the consideration of certain interesting experiments devised to illustrate the action of a set of contractile elements. Modifying the model of Heidenhain the author constructed a schema to illustrate cell division as follows: a circle of rubber tubing is made more or less rigid by steel rods inserted inside it or by means of a spiral spring—this represents the periphery of a cell; from the periphery to the center are stretched elastic bands of rubber which represent the astral rays; these are attached to two masses (forming the hub in this wheel) which may be at the centre or separated like the foci of an ellipse, when they represents the two centrosomes. According as the rim of the wheel is stiff or limp and the halves of the hub united or apart and according to the strength of the radiating bands various forms will be assumed by the system when at rest. By this scheme the author makes clear that a system of radiating contractile elements in conjunction with a somewhat resistant periphery can make various diagrams that show resemblances to phases of cell division in the behavior of the cell periphery, the length of the astral rays and the movements and positions of the centrosomes.

Besides emphasizing the part played by the cell periphery the author, by ingenious contrivances, estimates the amount that this periphery must grow or enlarge during cell division and here again seeks to bring in the assumed nuclear loss of liquid as a factor in the new formation of cell surface.

Though in the main adopting much of the conception of Heidenhain as to the part played by a system of contractile elements, the author does not suppose these elements are persistent cell structures handed on from one cell to another to do the work of cell division. Moreover he does not regard such radiations, when they are present, as anything like muscle fibrils but merely as indications of a rapid extraction of liquid leading to linear arrangements of vesicles and indicating lines of pulling force.

Continuity of Cells in Eggs.—August Hammar of Upsala having previously found[5] that the cells of cleaving eggs of echinoderms are connected by a superficial film of material, presumably protoplasm, has extended his observation and now claims that such intercellular connections are of universal occurrence. In the present paper[6] he describes and figures thin lines connecting the outer ends of *all* the cells of the cleavage and blastula stages of eggs from the following groups; Cœlenterates; Annelids; Mollusca; Tunicates; Mammals; Arthropods.

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[5] See American Naturalist, July, 1896, p. 597.

In life each cells has a faint outer periphery that is clearer than the rest; but it is only in sections that this layer, now seen as a stained line, passes over from one cell to the next so that the outermost contour of the entire egg is one continuous line of material.

In his method of preparation the cells split apart save for this peripheral line which thus becomes evident.

The author assumes that this connecting membrane is protoplasm, but it is unfortunate that he has no observations on living material to support this important claim and considering the remarkable effects often brought about by fixatives the question as to the true nature of this intercellular communication may well remain an open one. But the possibility that these connections may prove to be of similar nature to those described in the "spinning" of echinoderm eggs (AMERICAN NATURALIST, March, 1897) seems to the reviewer to add much to the probability that they are actual connections in the living egg.

From the author's point of view the blastula is one mass of protoplasm with a hole in the centre of it. He also points out the importance of the surface connection as a mechanical band; in fact he would ascribe to this many of the effects often attributed to surface tension of the individual cells. But regarding the connection as protoplasmic he emphasizes its importance as a *living* band and indicates its value as a basis for some of the assumptions of experimental embryologists as well as for the criticism of the cell theory by Whitman and by Sedgwick.

PSYCHOLOGY.[7]

Notes on Child Psychology—*Some Recent Literature.*—The past year has been one of remarkable activity in the sphere of Child Psychology everywhere, but especially in this country. *The Child-Study Monthly*, which was started in 1895, has published several articles of real value to the scientific investigator. The *Pedagogical Seminary* has been established upon a firmer footing. *Education, The Inland Educator, The Northwestern Journal of Education*, and other educational journals have devoted considerable space to child study. The works of Prof. Baldwin (*Mental Development in the Child and the Race*) and Miss Shinn (*Notes on the Development of a Child*) belong to the previous year; but two new studies of individual child development have appeared within the past twelve months. Mrs. K. C. Moore's monograph (*Mental Development of a Child*) is a very full record of the growth of her own child during its first two years; the author shows considerable judgment in her selection of material, as well as in its classification and discussion. Mrs. W. S. Hall has a similar study in hand, in a series of articles in the *Child-Study Monthly*, entitled *The First Five Hundred Days of a Child's Life;* five papers have already appeared; they are thorough and extremely suggestive. In connection with the statistical method, Dr. J. W. David, of Warsaw, reported at the Psychological Congress the results of a syllabus on the growth of ideas in children; he compared these results (on Polish children) with similar studies by other investigators in Germany and America. Mr. J. C. Shaw gives in the *Pedagogical Seminary* a statistical test of memory in school children. Prof. Sully's *Studies of Childhood*, while not statistical in method, contains a fund of material, new and old, on almost every topic of child study. Besides these general works, valuable contributions have been made by other writers to various branches of child psychology during the year.

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[6] Archiv f. Mik. Anat. März 4, 1897, pps. 92–102, pl. 6.

[7] Edited by H. C. Warren, Princeton University, Princeton, N. J.

Language.—It is interesting to compare the observations of Mrs. Moore (M) and Mrs. Hall (H) regarding the child's progress in learning to speak. The first sound observed by M was the short *a* uttered in crying; other sounds were made from the 36th day on, and ten days later responsive sounds were habitually made. No record was kept by H of the earliest babbling, except that the child began about the 47th day to "talk back" with the word "goo." H noted a distinction between the cries of hunger, pain, impatience and appeal by the ninth week, to which a cry of pleasure was added in the eleventh week. M noted different sounds for hunger and distress in the 12th week; these became real words by the 29th week. H observed the lip-movements corresponding to the words "mãma," "papa" and "bye-bye" in the 32th week. The child's spoken words were first associated by him with definite objects in the 42nd week in both cases. The growth of vocabulary differed somewhat in form and rapidity. H records 3 words learned at the end of the 10th month, and 12, 24, 38, 58, 106, 199, at the end of the succeeding months; at the end of the 500 days the child was familiar with 232 words. M does not mention the progress by months, but records a vocabulary of 5 words at the end of the 12th month, 384 in the 22d, and 570 in the 24th.

Nouns and interjections were in each case the first parts of speech used: the verb appeared next, in the 11th (H) and 16th (M) months. Since the number of interjections (acquired first, H) remained practically stationary, while the nouns increased rapidly, and since the number of verbs began to increase rapidly only during the 16th month (from 8 to 28 in this month, H), the difference between the two cases is not so great as might appear. If we bracket together (1) nouns and interjections, (2) verbs, (3) adjectives and adverbs, and (4) prepositions, pronouns and conjunctions, the order of acquisition of the parts of speech was the same. The order of relative importance, according to H, at the end of the 17th month, was (1) nouns, (2) verbs, (3) adjectives, (4) adverbs, prepositions and interjections (equal), (5) pronouns, etc.; the same order is given by M at the end of the 24th month, excepting that pronouns had risen to fourth place.

The first sentence (in each case, "Papa, gone,") was formed in the 48th (H) and 66th (M) weeks respectively. The interrogative form appeared in the 69th week (H), and between the 66th and 79th weeks (M). As one record closes with the 72nd week, it is impossible to follow the progress further in this direction.

The comparison of these records suggests the desirability of a more uniform classification of data, as well as the need of extreme care in interpreting them.

Drawing.—One number of the *University of California Studies* is devoted to four studies, by careful observers, of the progress of individual children in learning to draw. Prof. E. E. Brown summarizes the results in a supplementary paper. In the first stage (scribbling), he finds the chief element to consist in the pleasure in producing (making marks, changes); the interest is in the *process* rather than the product. Later, comes the notion of *representing* something; there is now a mingling of visual with the earlier motor images; the latter predominate at first, but in the course of time the visual picture comes to control the motor presentation. These observations, says Prof. Brown, agree with those of Prof. Baldwin, except that in the California investigations the children were generally not provided with a copy, and the advance was consequently not so rapid. Prof. Brown is unable to set any time for the first appearance of tracery imitation, and believes that this idea must be present in some dim form from the start. He emphasizes the importance of imitation as a stimulus to drawing, as well as an aid to progress in the art.

In the *Pedagogical Seminary* for October, Prof. H. T. Lukens contributes an interesting series of drawings by several children, beginning with the earliest attempts, at two years three months of age. He suggests a classification of the progressive steps in learning to draw, parallel to those in learning to speak. In language: I. Automatic cries and reflex or impulsive sounds. II. Imitation of sounds, but without meaning (babbling). III. Understanding of words, but no speaking beyond "mama," "papa," "no," etc. IV. Repetition of words as mere sounds. V. Use of words to express thoughts. VI. Study of grammar and rhetoric. In drawing the corresponding stages are: I. Automatic scribbling. II. Scribbling localizations and imitation of movements of other person's hands. III. Understanding of pictures; only simplest localization of features, by scribbling. IV. Copying from others to see how to get the right effect in the use of lines. V. Picture writing, illustrated stories, etc. VI. Study of technique; perspective, proportion, shading, etc. The central point, however, in the development of drawing, according to Prof. Lukens, is the elimination of scribbling and simplification of the drawings into a few telling lines.

Prof. Sully discusses children's drawings at considerable length in his book, and reproduces a large number of attempts to draw a man. These drawings are mostly of a comparatively late period of development, and show the growth of the ideas of features, proportion, relation of full face to profile, etc.; the earlier scribbling is scarcely touched on. Prof. Sully gives three stages of progress in drawing: (1) vague, formless scribble; (2) primitive design; (3) a more sophisticated treatment of the human figure.

The observations of Mrs. Moore and Mrs. Hall close with the 17th and 24th months, a period too early to furnish any data on the subject of drawing.

Intellectual Work and Fatigue.—Two interesting papers on this subject were read at the Psychological Congress. Prof. Ebbinghaus reported a series of tests on school children, in which it was sought to determine the relative capacity of different ages and sexes for intellectual work, as well as the effects of fatigue. Dr. J. Friedrich's paper, since published in full in the *Zeitschrift f. Psychologie,* gave tests of a single school class at intervals of an hour during the entire school day. The methods used by the two observers were different. Prof. Ebbinghaus used three tests. 1. *Calculation.* The method of Burgerstein was employed; pairs of figures were given to add and multiply, and the number of such operations completed in ten minutes was taken as test. 2. *Memory.* A series of figures was dictated rhythmically, and after the list was read the subject wrote the numbers down as he remembered them. The series consisted of from 6 to 10 figures. The number of errors was taken as inverse measure of memory capacity. 3. *Combination.* Prose sentences were given (in writing), with words, syllables and groups of letters here and there omitted; the pupil was told to fill in the omissions. The number of syllables supplied within five minutes and the number of errors made in filling in were both taken into account. (The latter is open to criticism, since a false filling in of the text might, in certain cases, make as good sense as the original.) Prof. Ebbinghaus's tests were made on 15 classes of boys and 11 of girls of all grades; the same hours and days of the week were used in every case. The results showed in general an increase in exactness and capacity for work, corresponding to the increase in average age of the class; but this was subject to individual variations, a lower class being in some cases better than the next higher, although about a year younger on the average. The Combination method gave greater differences according to age than the Calculation method; the Memory method, in the application of which the individuality of the instructor played considerable part, showed irregular results. Dividing each class into three parts, according to scholarship, the methods gave quite different results. The memory tests showed no marked difference between good and bad scholars—if anything, it favored the latter; calculation showed a slight decrease from higher to lower; the combination tests, on the other hand, showed a marked difference in favor of the better scholars, as regards both the number of syllables supplied and the freedom from error. Comparing boys with girls, the latter were found to be inferior in the lower classes, but were somewhat superior in the highest classes; from which was argued a more rapid mental development among girls from the 12th to the 15th year. As to fatigue, the results agreed in general with those of Burgerstein and Laser. The capacity for work increased steadily to about the end of the third school hour, and then decreased somewhat, rising sometimes at the end of the school day. But the number of errors increased steadily throughout from the start.

Dr. Friedrich employed two methods in his tests. 1. *Dictation.* Twelve sentences were given, of about the same number of letters and signs, and about the same degree of difficulty. 2. *Calculation.* This consisted of five sums of two 20-place numbers, and five multiplications of 20-place by 1-place numbers. Each test was made at the beginning of the school day and at intervals of one hour. Some days a recess of 8 or 15 minutes was allowed between the hours, on others the lessons following without intervening rest. Comparing the two cases, it was found that the intellectual capacity of the scholar diminished as the length of the lesson increased. The recesses proven efficient in remedying this, especially the longer intervals of 15 minutes. The author concludes that the one-hour lesson period is too long for the best results, and that a recess of at least 10 minutes should be allowed between each period.

Fear.—Prof. Binet's study of Fear in the *Année Psychologique* has already been noted in these pages. Stanley Hall treats the same subject exhaustively in a recent number of the *American Journal of Psychology.* Of 1,701 individual cases which he reports, nearly all are minors. 6,456 separate causes of fear are recorded: thunder and lightning was feared by the greatest number, 603; reptiles (483), strange persons (436), and darkness (432) follow next; then fire (365), death (299), domestic animals (268), disease (241), wild animals (206), water (205), insects (203), ghosts (203), rats and mice (199); a large number of other causes were confined to a few individuals. This classification is, perhaps, too minute for practical use. Combining the causes into larger classes, animals are found to be the cause of fear in 1,486 cases, celestial phenomena in 996, ghosts, etc., in 799, fire, water and drowning in 627, persons in 589, death or disease in 540. Pres. Hall points out the deep rooting of fears in human nature, and insists that the investigator must go far back in the organic series to reach any satisfactory ground for explanation.—H. C: W.

On the Effect of Music on Caged Animals.—Some time ago the writer was induced to experiment upon the animals in the Zoological Garden in Lincoln Park, with respect to the effect of music upon them, and the result may be of some interest to others working on psychological lines. The experiments were made at 6 o'clock P. M., two hours after feeding, and the instrument used was a violin.

Felis concolor Linné. Puma Panther. When the music first began two specimens of this species were resting in the back of the cage half asleep. At the first sound of the violin they started up, and could not for a time locate the sound, the writer being some distance from the cage. They showed, however, that they liked the sound, and when the player came as close as he could to the cage, they manifested their appreciation by lying down at full length and placing their heads between their paws. During this time the music had been of slow and sweet pieces, such as "Home, Sweet Home," "Annie Laurie," etc., etc. Suddenly, the player changed "Home, Sweet Home" to the "Irish washer-woman." At this change the panthers worked their tails nervously, and twitched their ears, and as it was kept up for a time, they got up and began pacing up and down the cage. From this action the writer judged that either the jig music, being sharp and piercing, hurt their ears, or that it was distasteful. After playing several jigs of this kind the player again relapsed into soft strains, when the animals slowly settled down in their old positions.

Felis onca Linné. Jaguar. This animal behaved much as did the panthers. While the jigs were being played he acted in a very nervous manner, jumping from a shelf to the floor of the cage and back again. Soft music seemed to quiet him. As the writer was leaving the jaguar's cage, having ceased playing for the time being, the animal walked up to the corner and reached out with his paw toward the player as far as he could. Whether this action was intended to call the player back, or was simply done to catch hold of him, as many animals will do if a person gets too near to the cage, the writer cannot say. It was a curious fact that when the paw was extended the claws were all *retracted.*

Felis leopardus Linné. Leopard. Two specimens of this species did not seem to notice the music to any extent, except at first, as a matter of curiosity.

Felis leo Linné. Lion. The lioness Juno, with her three cubs, occupied a large cage and the player's attention was next directed to these. While the music was being played to the other animals the lioness and cubs had been listening and watching, the cubs playing about their mother's haunches. As the violinist drew near the cage the cubs scampered behind their parent, the latter greeting the player with a gentle hiss As the music struck up a lively jig the cubs stood upon their hind legs and peeped at the player over her haunches. They appeared very curious and much puzzled, hearing these sounds for the first time. Desiring to test their appreciation, the player slowly backed away from the cage, playing all the time; as he retreated, the cubs gradually came to the front of the cage, and the mother crawled to the front and placed her two fore-paws between the bars and stuck her nose through as far as she could. After retiring to the side of the hall the player again moved toward the cage, but the family did not move, nor evidence any displeasure when he came very close to them, in fact, so close that he almost touched the great paws of the lioness. As he played the soft strains of "Home, Sweet Home" the cubs and mother sat motionless. in rapt attention, the former turning their heads from side to side. A jig played very rapidly caused the cubs to prance about in a lively manner.

Felis tigris Buff. Bengal Tiger. The music had a peculiar effect on the pair of animals in this cage. The male paid absolutely no attention to it, save glancing in the direction of the player and giving a vicious snarl. The female, however, acted as though she liked it, for she jumped upon a shelf and placed her paws and nose through the bars as described under the last species. A second experiment with the male, later, when he was stretched out upon the floor of the cage, caused him simply to look at the player, twitch his ears, and viciously spit and snarl at him. The female, however, on all occasions showed that music was not distasteful to her and that it was, on the whole, pleasing.

Hyena vulgaris Buff. Hyena. This animal is probably the most cowardly of all the mammals, and the only effect which music had upon two individuals was to cause them to retreat to the farther end of the cage and try to squeeze out between the bars. A lively jig frightened them nearly to death, and made them tremble in every limb. Strange to say, however, they did not howl or make the least noise.

Quadrumana. The Monkeys. (Genus *Cynocephalus.*) The monkeys evidenced great curiosity at the music, but did not seem to show either pleasure or displeasure at the sounds. A South American Sooty Mangabey, however, seemed to be rather pleased with the strains, particularly the jigs. This animal is of a quarrelsome disposition, and is therefore kept separate from the other monkeys. It was thought by Mr. Sweeney, the keeper, that the sounds might awaken a feeling of anger in him, but such was not the case. As the violinist drew away, he followed as far as his cage would allow. A spark of reason was observed in this animal. His cage is of glass all around, and in order to hear the music better he placed his ear to a crack in the door. This he did several times as the player drew near or went farther from the cage. The monkeys confined in the larger cage, also of glass, formed themselves in a broken semi-circle about that part of the cage nearest the violinist, and looked at him in apparent wonder. As he moved away from them, they arose from their sitting posture with one accord and followed him along the side of the cage. This was probably simply curiosity, although the music may have given them some pleasurable sensations. On the whole, the monkeys did not show as much intelligence as might have been expected from their high position in the scale of nature.

Pilecanus fuscus Linné and *P. erythrorhynchus* Gm. Brown and White Pelicans. The pen containing these birds is situated next to the monkey cage, and the music was next tried upon them. The effect was somewhat startling, for they all began to jump about, flap their wings, and snap their huge beaks; this might, perhaps, be called dancing.

When the violinist drew near the cage they snapped at him with their beaks.

The other birds in the animal house paid very little attention to the music, partly, perhaps, because they were sleepy. Several varieties of parrots, herons and smaller birds were tried in turn, but without producing any results worthy of mention.

Canis latrans Say. Coyote. The last experiment tried was upon a den of coyotes in the park. When the playing began all the animals were in their holes, but the first note had hardly been struck when they came running out, and raced up and down their den until they had located the sounds. When this was done they all squatted in a semicircle about the violinist, he having approached the bars of the den as near as possible, and sat in silence listening to the music. When it ceased they ran up to the player and pawed at him through the bars, indicating as plainly as possible that they wished to hear more. When he began to play again they again silently formed in a semi-circle. This experiment was tried a number of times, but always with the same result. During this time not a sound was uttered by the coyotes, but a wolf in the den adjoining howled lustily. Here, as in the other cases, soft, sweet music seemed to be better appreciated than loud, harsh music.

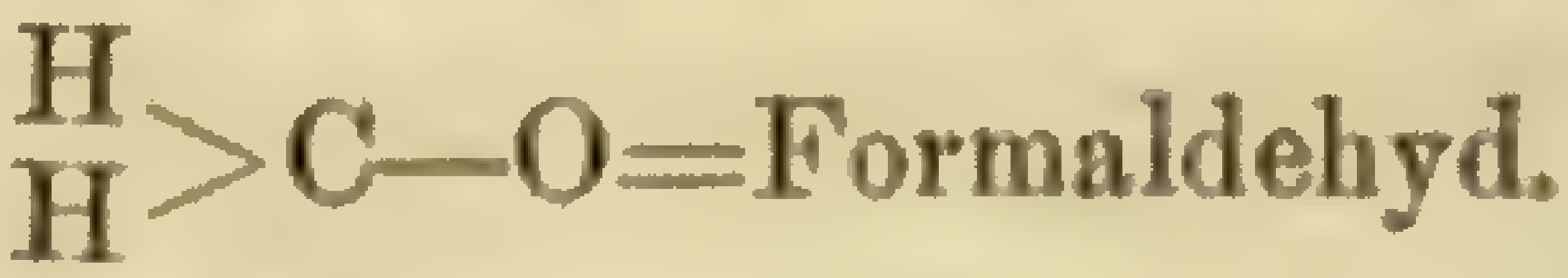
Besides music made up of regular pieces, all sorts of sounds were made by the violinist—screeches, piercing notes, imitations of a cat, cow-rooster crowing and pig squealing, but these did not seem to have much effect. The loud, harsh and piercing notes seemed to affect their ears, for they moved them about nervously as though the noise hurt the sensitive nerves. To sum up general impressions, slow and soft music was received, as a rule, with more signs of pleasure than the lively jigs. The females, also, seemed to pay more attention to the music, and to be more pleased with it, than were the males. The nocturnal mammals were more interested than were the diurnal birds. This was probably due to the fact that the experiment was tried after dark, when the animal house was lighted only by electricity. It was a curious and interesting fact that the whole performance was conducted without any noise other than an occasional grunt from the lions. The experiment is worthy of repetition, and should be made at different times during the day, as in the early morning and at noon, just before and after feeding, etc., to see whether or not these conditions have any effect upon the result. The writer is convinced that many interesting and valuable facts may be learned by experiments of this character.

—Frank Collins Baker.

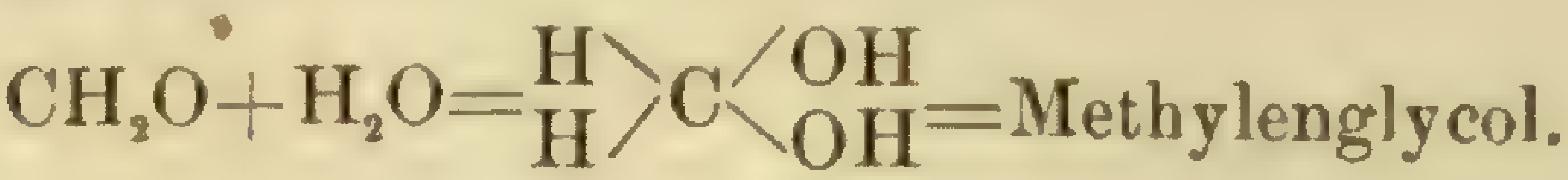
MICROSCOPY.

The Proper Angle for the Razor in Paraffin Sectioning.—In a discussion between Dr. M. Heidenhain and Dr. B. Rawitz relative to section cutting and the staining of microscopic preparations, the latter person[1] upholds the advice that he gave in his "Leitfaden," and adduces experimental proof to show that the microtome knife should be placed at an acute angle to the stroke rather than at a right angle. When placed at the latter angle the sections according to their thickness, are always more or less crowded together, thus distorting the finer structures of the tissue cut. The experimental proof consists of the measurement of sections cut with the knife at a right angle, and with it at an angle of 45°. The sections were from a block of paraffin measuring 20½ x 11½ mm., and had a thickness of 15μ, 10μ and 5μ. With the knife at the acute angle they all measured 11 mm. in breadth, while with the knife at a right angle they measured 9½ mm. for the 15μ, 9 mm. for the 10μ, and 8 mm. for the 5μ sections, thus showing a shrinkage of 2, 2½, and 3½ mm. respectively. In the case of the thinnest sections there is a loss in breadth of almost a third of the surface of the block, and such are somewhat incorrectly denominated 'sections'. They might be called "Quetschen."—F. C. Kenyon.

Formol, not Formal.—The paper by Bert B. Stroud in the January number of this Journal, induces me to make a few remarks regarding the nomenclature of the method of hardening by formol introduced by me into histological technique. Though I agree with the author that the terms formalin and formalose are bad and meaningless, I cannot agree to the objection to the denomination of the original fluid as "formol." To call the solution by the name of formaldehyde is not to be recommended, as formaldehyde, C_2HO, is a gas. The term formol is opposed by Stroud because the terminal syllable "ol" suggests an alcohol; but formaldehyde dissolved in water is no longer to be regarded as an aldehyde, but as a double alcohol, methylenglycol.



$$\left.\begin{matrix}H\\H\end{matrix}\right\rangle C{-}O = \text{Formaldehyd.}$$



$$CH_2O + H_2O = \left.\begin{matrix}H\\H\end{matrix}\right\rangle C \left\langle\begin{matrix}OH\\OH\end{matrix}\right. = \text{Methylenglycol.}$$

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[1] Bemerkungen über Mikrotomschneiden und über das Färben mikroskopischer Präparate. Anat. Anz. XIII, 65–80. Separat from the author.

Another reason for naming the original fluid "formol" might be that this is the oldest name for the watery solution of formaldehyde (Trillas) and that on its introduction into microscopic and preserving technique by my father and myself it was called "formol."

The law of priority therefor supports "formol."

The term "formal" is suited only to increase confusion.

In regard to Stroud's observations which are often contradictory of those of European workers—which he seems to have overlooked—I wish to remark that the behavior of formol towards egg albumen was a long while ago thoroughly studied by me, and that in a series of publications I have demonstrated that egg or sero albumen is not only not coagulated by formol, but on the contrary is, in a sense, rendered more fluid, since a compound, methylen-albumen, is formed that never coagulates even upon the solution being heated. This non-coagulating methylen-albumen I have designated "protogen," and have described its behavior in the test tube as well as in the organism.

To avoid the bad effect of formol on some tissues, which Stroud describes, it is only necessary to employ a more concentrated solution. To the 10 per cent. (formol 1., water 9) solution originally recommended by me a small addition of alcohol may sometimes be made advantageously.—DR. F. BLUM.

The Name of Formal.—TO THE EDITOR.—In answer to "A Protest," on pp. 267–268 of the March, 1897, number of THE AMERICAN NATURALIST, against my use of the terms Formal, etc., as given in the January number, if "A Comparative Anatomist" will consult an elementary text-book on Organic Chemistry he will learn :

1. That there is a good precedent for applying the term *Formal* to the compound H–CHO, and the very best authority for applying the suffix *-al* to any aldehyde, *e. g.*, *Chloral* $CCl_3.CHO$, Trichloracetic aldehyde, etc.

2. That the very example he quotes disproves the point he seeks to make.

The term *acetal* is derived "from *acetic* and *aldehyde* (Foster's Encyclopædic Medical Dictionary, Vol. I, p. 22). In the article, "Chemical Nomenclature," Dictionary of Chemistry, by Henry Watts, London, 1866, Vol. IV, p. 133, this statement occurs : "*-al* abbreviation of *aldehyde.* *Ex.* Butyral=Butyric aldehyde ; Valeral=Valeric aldehyde." To this it may be added that the highest authority in the world, namely, The Geneva Congress of Chemists, adopted the following : "Resolution 32. Aldehydes will be designated by the suffix *-al* (*Me-*

thanal, Ethanal)." (See abstract of their proceedings in *The American Chemical Journal,* Vol. 15, 1893, p. 58.) In view of the action of this Congress, the term *Methanal* would be the preferable one. But the term *Formal* is equally correct, and less likely to trouble persons already familiar with the substance.[2]

The writer's aim was to avoid confusion by the use of a term short, convenient, and correct; and he insists that *Formal* fulfils these requirements.

Respecting the strictly anatomic terms, "Comparative Anatomist" is referred to the article, "Neural Terms, International and National," in the last number of the *Journal of Comparative Neurology. Axon* was proposed in 1884 for the skeletal axis, whether a membranous tube, a cartilaginous rod, or a series of osseous vertebral centrums. *Alba* could hardly be mistaken for anything but *substantia alba. Tela* readily, if not inevitably, suggests the *tela vasculosa* of Huxley (*Zoological Proceedings,* 1876, p. 30), and the *tela chorioidea ventriculi* of Schwalbe's "Neurologie" (pp. 404 and 464), and the Report of the Nomenclatur Commission of the Anatomische Gesellschaft, 1895. All three terms are defined in recent English and medical dictionaries. Is not "Comparative Anatomist" needlessly magnifying his difficulties?—B. B. STROUD.

Ithaca, N. Y., March 13, 1897.

Formol or Formalin.—With reference to the present discussion over the proper name to be used for the 40 per cent. aqueous solution of formaldehyde, it may be said that had the author of the criticised paper that appeared in the January number looked up the chemical side of the question more carefully he would have found that there is another and much stronger reason for not using the term that he suggests than the very good one of priority, or the equally good one referring to the condition of the dissolved gas, cited by Dr. Blum. Had he read the account of formaldehyde given by Ladenburg in his "Handwörterbuch der Chemie" (Breslau, 1882), Vol. 1, on page. 195, paragraph 2, he would have found the following:

"Zu den sogen. Acetalen (Vergl., pag. 191) des Methylen-oxydes, welche als Alkoholäther der Aldehyde aufzufassen sind, gehören das Methylal oder *Formal,* $CH_2\ (O.\ CH_3)_2$, Methyläther, und der Methylendiäther, $CH_2\ (O.\ CH_5)_2$." The italics are mine.—F. C. KENYON.

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[2] As has been previously stated, (This Journal, January, 1897, p. 92) confusion has arisen from the indiscriminate use, by various writers, of the terms *Formalin, Formalose,* and *Formol.*

Correction—Foot note 1, p. 92, should read "——*Formal* from *Formaldehyde,* is a good scientific contraction".

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Boston Society of Natural History.—The general meeting was held Wednesday evening, April 7, 1897.—The following papers were read: Prof. J. Eliot Wolff, "The occurrence of Tourmalines at Mt. Mica, Paris, Me.;" Dr. C. B. Davenport, "The rôle of water in growth." Wednesday evening, April 21, 1897.—The following paper was read: Mr. Herbert Lyon Jones, "Some biological adaptations of our seaside plants." Stereopticon views were shown.—SAMUEL HENSHAW, *Secretary.*

New York Academy of Sciences.—Biological Section.—March 8, 1897.—The papers presented were: H. E. Crampton, "On the Ascidian Half Embryo." His experimental studies on the egg of *Molgula manhattensis* showed that the isolated blastomeres segment in a strictly 'partial' manner, but that a gradual passage to a total development ensues. As far as the early stages were concerned Chabry, Roux, Barfurth are entirely correct in arguing for a half or 'partial' development. But Driesch, Hertwig and others are also correct in considering the end results a 'total' larva of less than the normal size. The paper will be published in full.

N. R. Harrington, "On a Nereid from Puget Sound (Pacific Coast) which lives commensally with the Hermit crab, *Eupagurus alaskensis.* A variety of the Western European species *N. fucata* is known to inhabit deserted whelk shells with *Eupagurus bernhardus* and a careful comparison of the Old and the New World forms brings out resemblances in structure due to the operation of the same physiological factors. These are notably (1) the degeneration of the muscular and cuticular layers in the posterior two-thirds of the body, (2) loss of the pigment in the same, (3) physiological factors may explain why only females have been found (as yet) in this comfortable and nutritive habitat. The author surmises that the commensal form is the female Epitocous type of some free living nereid.

This apparently undescribed species from the Pacific differs from *N. fucata, B. inquilina* of Wirèn in the arrangement of the paragnathi, respiratory lobes of notopodium and transverse pigment stripes.

Bashford Dean, "A Posthumous Memoir of Prof. J. S. Newberry. This paper described new species and a new genus of North American fossil fishes, and discussed the genera Oracanthus, Dactylodus, Polyrhizodus, Sandalodus, and Petalodus.

Among the types were species of Cladodus, Oracanthus, Ctenacanthus, Stettacanthus, Asteroptychius, Dactylodus, Deltodus, Sandalodus, Psephodus, Heliodus, Ctenodus. *Dinichthys corrugatus* was taken as a type of a new genus Stenognathus.

At the conclusion of the papers, an election of sectional officers was held. Prof. E. B. Wilson was elected chairman for the ensuing year, Prof. C. L. Bristol, Secretary.—Bashford Dean, *Secretary.*

New York Academy of Sciences.—Section of Geology.—March 15, 1897.—The first communication of the evening was by Mr. Hienrich Ries entitled "Mineralogical Notes." Mr. Ries spoke of some Allanite crystals with new faces; also of some large crystals of fibrous gypsum from Newcastle, Wyoming; also exhibited some large Childrenite crystals from Maine and some Amphibole crystals with many terminal faces from Virginia. He also spoke of some Pseudomorphs of gold after Sylvenite from Cripple Creek, Colorado, The finding of a new Beryl crystal with an unusually large number of terminal faces in New York City was also noted.

The second paper of the evening was written by Mr. Herbert Bolton, entitled "The Lancashire Coal Field of England" and read in abstract by President Stevenson. The paper spoke of the geographic conditions of the Lancashire coal field and its neighborhood, of the extent and quality of the coal and of the age of the structural movements which had caused the present geological characteristics in the coal area. A careful correlation was made between the coal measures of this field and the deposits of the United States. Distribution of the fauna and flora and their character was taken up in some detail and it was shown that in the lower coal measures the life is mostly marine, in the middle coal measures of fresh and brackish origin, and in the upper coal measures that the fauna was scarce. When published this paper will be a valuable contribution to the literature of coals and will be of great assistance to workers in America in their endeavors to correlate the deposits on the two side of the water.

The third paper of the evening was by Stuart Weller, of Chicago University, entitled "The Batesville Sandstone of Arkansas," abstracted by Mr. Gilbert Van Ingen. The paper entered into some detail regarding the Batesville section and the fauna of the Batesville sandstone in that section. Of the invertebrates thirty species have been found, of which eleven point to the St. Louis age of the sandstone, six to the Kaskaskia age, while thirteen are of indeterminate value. On account of the greater abundance of the numbers of specimens of the second group and from stratigraphic evidence as well, it is probable that the sandstone belongs in the base of the Kaskaskia group and is the same as the Aux Vasa limestone of Southern Illinois. This paper gives the data wherein to correlate the Mississippian section with the section about the Ozark Hills.—April 19, 1897.—The evening of the monthly meeting of the Section was devoted to a reception by the whole Academy to Sir Archibald Geikie, Director-General of H. M. Geological Survey of Great Britian, who has just returned to this country for a brief visit after an absence of eighteen years. After an informal reception the meeting was called to order and addressed briefly by the President of the Academy, Prof. J. J. Stevenson, who extended a most hearty welcome from the scientists of New York to the guest of the evening. Prof. Stevenson was followed by Prof. J. F. Kemp, the Chairman of the Section, who reviewed in a few words the greater contributions of Sir Archibald Geikie to the cause of Geology. He spoke of his early work in Scotland, in France and in the Western United States in the study of vulcanism, and paid particular attention to the work that had been done in Scotland on the metamorphic rocks. Prof. Kemp concluded with a tribute to Sir Archibald as a naturalist and spoke of the superior quality of work that is given the world by the man who is in love with nature and finds in the solitude of the wildness of nature his greatest company and inspiration.

The next speaker was the Secretary of the Section who spoke particularly of the work of Sir Archibald Geikie as looked at from the standpoint of the teacher and physiographer. He reviewed hastily the character and quality of Geikie's Text Book and Class Book of Geology and spoke more especially of the example this distinguished geologist has set in physiography in the masterly analysis of the physical features of Scotland given in his Scenery of Scotland.

The last address of welcome was given by Prof. Angelo Heilprin of Philadelphia who spoke as a traveler and contrasted the knowledge of the geology of the world now with our knowledge at the time of Humboldt. He spoke of how much we owed to the guest we were welcoming for his work in bringing together the shreds of knowledge from all parts of the world and in building up a great mass of geological information, which is a vast help to all workers in geology and a stimulus to all.

In reply Sir Archibald Geikie expressed his thanks to the Academy for the very cordial reception that had been tendered him in New York. He contrasted the appearance of the city eighteen years ago and now, and spoke of the great growth of New York vertically as well as horizontally. He paid a brief word of tribute to his friends of his former visit, particularly Newberry, Leidy, Dana, Cope and Hayden, whose help and good will have ever been a great inspiration to him.

In reviewing the work of world wide reputation that the American geologists are producing, Sir Archibald Geikie paid a warm tribute to their industry, their perseverance, their breadth and to their scientific acuteness. He contrasted in a very favorable way to the United States the policy of the British and United States Governments in regard to the printing, publishing and distribution of government reports.

After these brief addresses an opportunity was given for meeting the guest of the evening for personal social meetings among the members of the Academy, and for greeting the guests from a distance including several well known geologists.—RICHARD E. DODGE, *Secretary.*

Torrey Botanical Club.—At the regular meeting of Feb. 9th, about 200 persons present, the scientific program consisted of a lecture by Mr. Henry A. Siebrecht, entitled "Orchids, their habitat, manner of collecting and Cultivation"; handsomely illustrated with lantern-slides by Mr. Cornelius Van Brunt, colored by Mrs. Van Brunt.

Mr. Siebrecht in his paper referred to the hardships undergone by the orchid-collector, and paid a tribute to the energy displayed by three friends of the speaker, Carmiole, an Italian, who had come to New York when the speaker was a boy; Föstermann, who died about two years ago, the victim, like most collectors, of disease contracted in that enterprise; and Thieme, who had made three trips for Mr. Siebrecht, and who went last to Brazil in search of the *Cattleya autumnalis* but was never heard from.

Mr. Siebrecht referred also to three trips of his own in quest of orchids, to the West Indies, Venezuela, Brazil and Central America. He then exhibited the lantern views, which were of remarkable beauty and evoked frequent applause. They included numerous representatives of the chief tropical genera cultivated, also with views of interiors showing the Cattleys house in full blossom, etc. Slides showing numerous species native to the Eastern United States, followed.

Mr. Siebrecht then described the culture of orchids and classed their diseases, as chiefly because too wet, when the "spot" closes the stomata, or too dry, when they collect insects. He referred to their insect enemies at home, the "Jack-Spaniard" which eats the marrow from the bulb, and the Cattleya-fly, now introduced into English houses. He mentioned the ravages of *Cladosporium*, and the great difficulty with which orchids of the genus *Phalænopsis* are preserved from fungal diseases.

The subject was further discussed by the President, Dr. Britton, Mr. Samuel Henshaw, and Mr. Livingston, the latter referring to his recent experience as an orchid collector. A slide was exhibited, made from a photograph taken by Mr. Livingston showing his orchids packed upon oxen and so carried down from the mountains to Magdalena.

Mr. Henshaw spoke of his visit to Mr. Siebrecht's nursery in Trinidad, and of the growth made there by Crotons, as much in one year as here in four or five. In those gardens they divide their plants by rows and edges of Crotons which are sheared off as we would trim a privet-hedge. Mr. Henshaw also paid a deserved tribute to Mrs. Van Brunt for the wonderful success of their coloring of the orchid slides.

February 24, 1897.—The first paper was by Mr. Arthur Hollick, "A fossil *Arundo* from Staten Island."

This paper, which is to appear in the *Bulletin,* was presented by Dr. Britton, with prefatory remarks referring to this discovery. Its occurrence was in yellow sand of Staten Island belonging to late Tertiary or early Quaternary; the locality, a pit near Fort Wadsworth. The preliminary reference to *Phragmites* is now changed by Mr. Hollick to the tropical genus *Arundo.*

A paper followed by Mr. E. O. Wooten, "Remarks on some of the rarer Plants of New Mexico."

Mr. Wooton sketched briefly the botanical regions of New Mexico, dividing the territory by differences in the flora into (a) the river valleys, (b) the table-lands or *mesas;* (c) the dry, rocky and narrow mountain ranges, and (d) those areas which are of uniformly high altitude and have numerous mountain ranges closely associated and more or less timbered. He also traced upon a map the routes trasvered by most of the botanical collectors who have visited New Mexico, beginning with Pike and including Long, Gregg, Wislizenus in 1846, Emory, Marcy, Sitgreaves, and Woodhouse, with the work of the Mexican Boundary and other surveys, 1849 and after. Mr. Wooten was himself practically the first to make collections in the south-east section of the territory, a very interesting, botanical region, with high mountains, some of which were illustrated by photographs. Specimens of Mr. Wooton's collecting were then shown exhibiting about 35 flowering plants and ferns, and including among those familiar in the east, *Pellœa atropurpures, Cystopteris fragilis, Pteris aquilina* and *Cheilanthes tomentosa.*

Discussing Mr. Wooton's presentation, Dr. Rusby spoke of his own former travels in New Mexico, and of various incidents of that journey, as of the discovery of *Primula Parryi* on the top of Gray's Peak (central Arizona) blooming on July 2d under three or four inches of snow which had just fallen.

Mr. Rydberg compared some of the features presented by the sand region of Central Nebraska; referred to *Muhlenbergia pungens* and other so-called "*blow-out grasses*" of the sand-hills; and described the formation of the characteristic "blow-outs" or hollows, originating in spots where the grasses had died out, and deepening rapidly, sometimes to 300 feet, producing a country where the hills are moving every year, and where when camping he could find no fuel except roots of sand-cheeries exposed along fresh "blow-outs."

Discussion by Dr. Allen, Mr. Wooton and Dr. Rusby followed relative to the loco-weed poison. Mr. Wooton said that species (formerly *Oxytropis*) *lamberti* is the chief *loco-weed* about Flagstaff (Arizona); that cattle men claim that the well fed animal will not touch it, but that those which have formed the taste will not eat anything else. Reasons were urged by the speakers for the belief that the results of the loco-weed are due simply to mal-nutrition, or to effect of seeds alone, or to a posion (as extracted by Sheldon) diffused in very minute quantities throughout the plant.

The next paper was by Dr. H. M. Richards of Barnard College, "On some of the Reactions of Plants toward Injury."

Dr. Richards spoke on certain effects of wounding upon the functions of various plant organs as shown by his own experiments in Germany last summer. Diagrams illustrating the effect of injury upon both respiration and temperature were shown. In the former case it was seen that the respiration is greatly increased by wounding, attaining its maximum about 24 hours after the injury was inflicted; this increase depending both on the stimulus of the wound itself and upon the access of atmospheric oxygen to the tissues. The occurrence of a corresponding rise in temperature, of a local nature, was also briefly referred to; the temperature curve corresponding closely to that described by the increased respiratory activity. The thermœlectric apparatus used was described; its delicacy is such as to indicate a difference of $\frac{1}{400}$ of a degree; the result with potatoes showing a maximum rise of temperature of a little over $\frac{2}{10}$ of a degree at the end of the second day, falling to the end of the 5th day. A remarkable temperature rise in the onion of nearly $3\frac{1}{2}$ degrees was explained by the fact that here the rise was not local but affected the whole onion, in accordance with its morphological structure, and with the fact that metabolism is carried on very fast in the onion.

The paper was discussed by Dr. Jelliffe and by Dr. Britton, especially with regard to the sudden escape of CO_2 after wounding, Dr. Richards considering it to be due largely to contents of intercellular spaces, but partly to solution within the cells; potatoes contain a very considerable amount of enclosed CO_2, a quart of it being obtained from a pound of potatoes. Dr. Richards distinguished carefully the coincident but independent escape of a slight amount of CO_2 always given off, even in pure hydrogen; to be called "intermolecular respiration."

The next paper was a contribution read by title, from Dr. Alexander Zahlbrückner of Vienna, a corresponding member of the club, entitled, "Revisio Lobeliacearum Boliviensium hucusque cognitarum." The paper, which is in Latin, enumerates all the species, giving synonymy and references to the literature, and cites collectors and their numbers. There are 39 species, as follows: 9 in *Centropogon*, 2 new; 20 in *Siphocampylos*, 7 new; 1 in *Laurentia;* 2 in *Rhizocephalum;* 3 in *Hypsela;* 4 in *Lobelia.* The paper will be printed in the *Bulletin.*

Tuesday evening, March 9, 1897.—The evening was devoted to ferns with papers as follows:

1. Mrs. Elizabeth G. Britton, "Notes on some Mexican Ferns;" presented in Mrs. Britton's absence by Dr. Rusby, with exhibition of numerous specimens, including species of Pellæa, Polypodium, Cystopteris and Cheilanthes. Dr. Rusby, having been himself present at their collection, described vividly the tongue of hard, black lava on which the collectors walked, and which was filled with large cavities often forming caves, containing some accumulation of soil and crowded with a luxuriant growth of ferns although in November and practically the winter season.

2. Mr. Willard N. Clute, "The New York Stations for *Scolopandrium.*" Mr. Clute contrasted the wide distribution of the Hart's tongue fern in the old world, from the Azores to Japan, with the extremely local North American occurrence, in five areas only, Mexico, Tennessee, Central New York, Owen Sound in Ontario, and New Brunswick. The Central New York locality was made known early in the present century through John Williamson, and was visited by Pursh in July, 1807, who found it five miles west of Syracuse on the farm of J. Geddes, where it has recently been rediscovered. About 1827, Wm. Cooper discovered it at Chittenango Falls where Mr. Clute found hundreds of plants growing last summer. Mr. Clute described the Chittenango ravine and its ferns. On sunny exposures of the limestone walls of the ravine grow rue spleenwort and purple cliff-brake in quanities; in shady places, the slender cliff-brake; on the talus, upon the larger bowlders,

the walking fern, and in the shade of these bowlders, the Scolopendrium, chiefly in clusters of 2 to 6, at first erect, finally somewhat drooping, and ripe in September. Mr. Clute added that the species seems to be increasing at present, being now under the protection of an association.

Prof. Burgess remarked upon the former scarcity of the fern in that locality as reported to him by Dr. Torrey of Chittenango about 1874, and by Dr. Morong who could find none at his visit about 1876.

Prof. Underwood spoke of the Jamesville locality, also on the corniferous limestone in Onondaga Co., where 20 years ago he found it quite common about two small lakes, but becoming soon exhausted at the one most frequently visited. He queried why it should not occur at other ledges of the corniferous limestone throughout Western New York, and why it should confine itself to that rock here while in England it frequents sandstone, shale and limestone indifferently. Dr. Britton then remarked that in Europe (and Nova Scotia) *Campanula rotundifolia* grows in meadows, but here on rocks; *Cerastium arvense* also grows in Europe in fields, but here on rocks.

Dr. Britton said that Scolopendrium is probably a case like that of Sequoia and Brasenia of originally much wider distribution, where the isolated plants owe their survival to favorable conditions. He cited Epipactis among orchids as a parallel in distribution, confined here to Central New York and Ontario, but wide-spread in the old world.

Mr. Benj. D. Gilbert added an interesting comparison of the growth of Scolopendrium at stations where he had collected it at Jamesville and Chittenango Falls, also in southern France, northern Italy, and Undercliff in the Isle of Wight. In the warm shelter of the latter place, it is more luxuriant than anywhere else, showing great tendency to sport, displaying forking tips and deeply cordate bases as at Chitenango Falls.

3. The third paper was by Mr. B. D. Gilbert, of Utica, N. Y., entitled, "New and interesting Ferns from Bolivia," with exhibition of specimens of two new ferns, *Blechnum nigro-squamatum* and *Nephrodium villosum inæquilaterale* Gilbert, the first peculiar in being fully pinnate, the second in being a one-sided dwarf persistently under a foot and a half high, instead of 4 or 5 feet as its type.

4. The fourth paper, also by Mr. Gilbert, "Jamaica, the Fern-Lover's Paradise, described the abundance of species and of individuals which the speaker had collected there, illustrating the subject by numerous specimens. He remarked that Swartz in his *Species filicum*, 1783–'86, enumerating all then known ferns, described 709 species; of which 149 were from Jamaica; the Jamaican number was raised to 300 by

Grisebach and now to 500 by resident botanists there, an estimate confirmed by Mr. Gilbert. Probably no other equal area produced half that number. Among reasons which account for this are the warm latitude of Jamaica, its south shore sheltered from coolor breezes by a mountain-wall, its mountains themselves rising to 7,000 feet and reaching into a cool temperate climate, and its great variation in moisture, with daily rains in the mountains and sometimes but twice in six months on the plain. Mr. Gilbert described in particular his experiences with the tree-ferns reached by a long journey on foot, high in the Blue Mountains, there forming unmixed groves, their stems supplying the only wood readily obtainable. One, *Alsophila armata*, reaches 50 feet in height, though its slender stem is but a few inches in diameter. No class of ferns is as yet so poorly described, as the tree-ferns; description should be from the living specimen and at the locality; the only such in English are those in Thwaites' Flora of Ceylon. Jamaica is remarkable in particular for its numerous Filmy Ferns, 26 species (out of 280 known); these are all in the three eastern parishes. In the east part *Blochnum occidentalis* is the common fern of the roadsides; *Polypodium reptans* was seen everywhere, now growing erect; one bank 30 x 25 feet was completely covered with *Gleichenia pectinacea.* The great number of endemic species is surprising; as if the work of differentiation had gone on there with greater activity and vital power than anywhere else in the world; every genus in Jamaica shows one or more endemic species.

Mr. Gilbert closed by exhibiting specimens of three new species from Jamaica, belonging to *Asplenium*, *Dryopteris* and *Polypodium,* and also of a number of rare species as *Entomosora campbellii*, *Gymnogramma schizophylla* and *Adiautum candollei.* His paper was discussed by President Brown, Prof. Underwood and Dr. Rusby, the latter referring to the uses made of tree-ferns in New Zealand, as compared with the use for timber and for posts in Jamaica.—EDWARD S. BURGESS, *Secretary.*

The Chicago Academy of Sciences.—The spring course of lectures for 1897 were as follows: March 12. Amelia Weed Holbrook, "*The Antiquity of (so-called) Modern Inventions.*" March 19. Alja Robinson Crook, Ph. D., Professor of Mineralogy and Petrology, Northwestern University. "*Some Geological Causes of the Scenery of Yellowstone National Park.*" Illustrated with stereopticon. March 26. Frank Collins Baker, B. S. Secretary and Curator, Chicago Academy of Sciences. "*The History of Creation as Revealed in the Rocks.*" In this lecture, ideal landscapes and curious animals of prehistoric ages was shown by the stereopticon. April 2. A. W. Hitt, M. D. "*Leprosy, its Causes and Prevalence.*" Illustrated with stereopticon. This lecture was a popular talk upon this little known subject. April 9. Frank Collins Baker, B. S. "*Types of Animals.*" This lecture was a repetition by request, with some modifications, of the lecture given in February on the Evolution of Animals. The school children were particularly invited, as it was intended more for their instruction, than for the older members of the audience. April 16. H. H. Brown, M. D., Professor of Didactic and Clinic Ophthalmology, Illinois Medical College. "*The Eye.*"

The Biological Society of Washington.—The 274th regular meeting was held on Saturday evening, March 27, 1897, in the Assembly Hall of the Cosmos Club, after Brief Informal Notes and Exhibition of Specimens, the following communications were read: M. B. Waite, "Factors Governing Pear Blight"; Theo. Holm, "The Grass Embryo and its Constituents"; E. A. De Schweinitz, "Some Methods of Generating Formaldehyde and its use as a Disinfectant.—FREDERIC A. LUCAS, *Secretary.*

Anthropological Society of Washington.—The 263d Regular Meeting of the Society was held in the Assembly Hall of the Cosmos Club, on Tuesday, April 20. "Scopelism," Dr. Robert Fletcher; "Unusual Frequency of Wormian Bones in the Coronal Suture of Artifically Deformed Kwakiutl Crania," Mr. George A. Dorsey; "Measurements and Indices of the Long Bones of the Kwakiutl and Salish Indians," Mr. George A. Dorsey.—WESTON FLINT, *Secretary Board of Managers.*

N. S. I. S.—The Ordinary Monthly Meeting of the Nova Scotian Institute of Sciences were held in the Legislative Council Chamber, Province Building, Halifax, on Monday, the 12th of April. The following papers were read: "A Note on our Calcareous Algæ," by A. H. MacKay, Esq., LL. D., F. S. Sc., F. R. S. C. Superintendent of Education; "Zoological Notes," by Harry Piers, Esq.—HARRY PIERS, *Secretary.*

The Association of American Anatomists.—March 30, 1897.—The next meeting of this Association will be held in Washington city in connection with the Congress of American Physicans and Surgeons, Tuesday to Thursday, May 4 to 6, 1897.

The meetings of the Congress will be held in the Columbia Theater, corner of Twelfth and F Streets, N. W., from 2 to 5 P. M. daily. Those of this Association accordingly will be held in the mornings, from 9 to 12.30, unless otherwise ordered by the Association, and in the Physical Laboratory of Columbian, University, corner Fifteenth and H. Streets, N. W.

The titles of but four papers have thus far been received, to wit: by Dr. Wilder, "Notes on the Biceps" and "The definite encephalic segments and their designation;" by Dr. Stroud, "Comparative anatomy of the cerebellum" and "On Brain Preservation;" all of them illustrated by specimens, photographs and charts.

Members who intend to read papers or present specimens will please send titles to the Secretary as soon as convenient, that they may appear on the printed program.

The statue of Prof. Samuel D. Gross will be dedicated during the Congress.

Blank forms of application for membership will be sent on application.—D. S. LAMB, *Secretary and Treasurer.*

The Academy of Science of St. Louis.—At the meeting of the Academy of Science of St. Louis held on the evening of April 5, 1897, Professor Frederic Starr, of the University of Chicago, briefly addressed the Academy on the functions of such organizations, with especial reference to the local problems. Mr. H. C. Irish presented a paper on the relations of the unfolding of plants in spring to meterorological conditions, in which were embodied deductions drawn from a series of observations made at the Missouri Botanical Garden, and those by other observers, extending back to the time of Stillingfleet, in the last century. Mr. Charles Robertson presented for publication a paper entitled North American Bees—Descriptions and Synonyms.—WM. TRELEASE, *Secretary.*

The Botanical Seminar of the University of Nebraska.—February 27, 1897.—The Periodicity of Flowering, Mr. F. E. Clements; Herbaceous Vegetation-Forms, Mr. Roscoe Pound; The Karyology of the *Ascomycetes*; a Review, Mr. C. L. Shear; Organogeny of the Genus *Prunus*, Mr. A. T. Bell. March 27, 1897.—Chimney-shaped Stomata in Greatly-thickened Epidermis, Dr. C. E. Bessey; Seed Production and Disseminations as Accessory Characters, Mr. F. E. Clements; Statistics Ecological and Distributional of Nebraska Grasses, Mr. Roscoe Pound; The Origin of the rudimentary Ovules in Clematis, Mr. Ernst A. Bessey.

SCIENTIFIC NEWS.

Prof. Edward D. Cope died in Philadelphia, April 12, 1897, aged 56 years.

Among the recent calls and advancements in position we note the following: Karl Futterer to the professorship of mineralogy and geology in the Technical School at Karlsruhe; Peter August Pauly to the head of the zoological institute of the experiment station recently established in connection with the University of Munich; Dr. Erich Wernicke to be professor extraordinarius of hygiene in the University of Marburg; Dr. Alexander P. Anderson to the professorship of botany in Clemson College; Dr. Fritz Noll to be titular professor of physiology in the University of Heidelberg; Dr. Carl Burckhardt, of Basel, to the position of geologist in the Museum of La Plata; Dr. Leo Wehrli, of Zürich, to be mineralogist in the same institution; Dr. Lugni Buscalioni, of Turin, to the assistantship in the Botanical Institute of the University of Rome; Dr. Pietro Cannarella to be assistant in the Botanical Garden at Catania; Anton Pestalozzi, assistant in the Botanical Museum of the University of Zürich; Dr. Johannus Petruschky to the directorship of the Hygienic-Bacterological Institute in Danzig; Dr. Hermann Ross, of Palermo, to the position of custodian of the Botanical Gardens of Munich; Wladimir Iwan Palladin, of Charkoff, to the professorship of Botany in Warsaw; Dr. Siedentopf, of Göttingen, to the position of assistant in mineralogy in the University of Griefswald; Dr. Karl Eckstein to be titular professor of zoology in the Academy of Forestry at Eberswalde; Dr. Ludwig Plate to be titular professor of zoology in the University of Berlin; Dr. William E. Castle to the instructorship of biology in Knox College; Dr. Romeo Fusari to the professorship of human anatomy in the University of Modena; Dragutin Gorjanovish-Kramberger to the professorship of geology and paleontology in the University of Agram; Anton Heinz to the professorship of botany in Agram; Dr. Mijat Kishpatish to the professorship of mineralogy and petrography in Agram; Dr. Hans Lenk, of Erlangen, to the professorship of geology and mineralogy in the University of Würzburg; Dr. Giulio Valente, of Perugia, to the professorship of human anatomy in the University of Catania; A. Engler to the professorship of forestry in Zürich; Dr. Walter Felix to be professor extraordinarius of osteology in Zürich; Dr. Siegfried Mollier, of Münich, to be professor extraordinarius of anatomy in Göttingen; Dr. Umberto Rossi, of Florence, to be professor extraordinarius of human anatomy in Perugia; Dr. Joseph Kriechbaumer to be conservator of the Zoological Collections in Munich; J. J. Luehmann to the directorship of the Herbarium of Melbourne; Johannes Rüchert to the professorship of descriptive and topographical anatomy in the University of Munich; Pasquale Baccarini to the professorship of botany in the University of Catania; Prof. Alexander Fischer von Waldheim, of Warsaw, to the position of director of the Botanical Gardens in St. Petersburg; Dr. Oswald Kruch to the professorship of botany in the Agricultural Institute in Perugia; Isaac H. Burkell, of Cambridge (Eng.), to a position as assistant in the Kew Herbarium; Emilio Chiovenda to the conservatorship of the Botanical Collections of the University of Rome; Dr. Biagio Longo as assistant in the Botanical Institute of the University of Rome; Dr. Achille Terracciano as assistant in the Botanical Institute of Palermo; Dr. Beckenkamp, of Mülhausen, to the professorship of mineralogy at Würzberg; Dr. Gaupp to be professor extraordinarius of anatomy at the University of Freiburg.

Recent Deaths:—Dr. Emile Moreau, ichthyologist, at Paris, September 11, 1896; Joseph Chappell, entomologist, at Manchester, Eng., October 3, aged 67; Dr. Rudolf Raimann, botanist, as Vienna, December 5, aged 33; Joseph Ullepitsch, botanist, at Wilfersdorf, Austria, December 16, at the age of 68; Professor Joseph von Gerlach, anatomist, of Munich, December 17, aged 76; Ferdinand Morowitz, Vice-President of the Russian Entomological Society and a student of Hymenoptera, December 17, aged 70; Lugui Calori, professor of anatomy in the University of Bologna, December 19, aged 90; Dr. Theodor Lickfett, director of the Bacteriological Institute in Danzig, December 28, aged 49; Heinrich Gaetke, ornithologist, of Helgoland, January 1, aged 83; Franz von Baur, Professor of Forestry, at Munich, January 2, aged 66; Dr. August Streng, professor of mineralogy, at Giessen, January 7, aged 67; Dr. A. A. van Bemmeln, director of the Zoological Garden at Rotterdam, January 9; Dr. Karl Heitzman, anatomist, at Rome, aged 61; Sven Anders Bernhard Lundgren, professor of geology in the University of Lund, January 7, aged 53; Alois Rogenhofer, student of Lepidoptera, at Vienna, January 15, aged 65; Salvatore Trinchese, professor of comparative anatomy in the University of Naples, January 18; Hermann von Nordlinger, formerly professor of forestry in the University of Tübingen, at Stuttgart, January 19, aged 78; Frederick Isaac Warner, botanist, at Winchester, Eng., November 8, aged 54; Antonio Cecchi, African traveller, killed by the natives in Somali Land, November 26; Dr. Paul Taubert, botanist, at Manaos, No. Brazil, January 1; C. F. Wiepkin, for nearly 60 years director of the Museum at Oldenburg, January 29; Constantin, Baron of Ettinghausen, phytopaleontologist and professor of botany in the University of Graz, February 1, aged 76; Dr. Otto Buchner, in Giessen, February 5, aged 68 years; Dr. Filippo Togrini, conservator of the Botanical Institute at Pavia; Ernst Georg Dannenberg, lichenologist, at Fulda, Germany, December 4; M. Thollen, botanist and chief of the exploration of the French Congo, at Libreville, January; Jean Baptiste Barla, director of the Natural History Museum in Nice; Dr. Berthand, professor of geology in Lille; Georg Gercke, student of Diptera, in Hamburg; Jaroslar Koshtal, assistant in zoology in the Technical School at Prague.

Veteran Scientist Honored.—The Kansas Academy of Science at its recent annual meeting at Topeka placed the name of Chaplain John D. Parker on the roll of life members, as a recognition of his effective services in organizing science in the west. During the last thirty years he has originated the following scientific associations, viz.: Kansas Academy of Science, Kansas City Academy of Science, and California Science Association. The Indiana Academy of Science and the Ohio Academy of Science were organized on the plan of the Kansas Academy of Science, and under the scientific impulse derived from it, and the Ohio Academy of Science was originated by one of its former members. The field occupied by these academies contains a third of a million square miles, and about 10,000,000 people, whose opportunities for scientific knowledge have been greatly increased by these societies. About 1,000 men and women are connected with these associations, representing every branch of science, and many of these scientists have become distinguished in their various departments.

Chaplain Parker says he has pursued this life work most assiduously, but at times under great financial discouragements, and sometimes in sickness and pain and feebleness, still it has been the joy of his life, and he has great satisfaction in knowing that his associates and fellow workers have accomplished such a noble and enduring work for science.

When Chaplain Parker came to San Diego five years ago, his physician despaired of his life. Now, under the magical influence of this climate, his health is nearly recovered, and he looks forward hopefully to future years of usefulness.—*The San Diegan Sun.*

Mr. Lawrence Bruner, of the University of Nebraska, has sailed to Argentina to study the ravages of the locusts, which have recently developed into a terrible pest, certain regions being completely devastated by them. The Argentine Government has appropriated $400-000 for relief while a syndicate of business men have raised funds to employ an entomologist to study the question. Mr. Bruner will remain a year at their expense. His labors as an economic entomologist have especially fitted him for this work. His place at Nebraska will be filled by his assistant, Mr. Hunter, during his absence.

The National Academy of Science has appointed Dr. Theodore N. Gill to prepare the biography of the late Professor Cope. Professor Cope was to have delivered the address as retiring president before the American Association for the Advancement of Science at its Detroit meeting. Dr. Gill as first vice-president will be the acting president and will deliver a memorial address upon the scientific work of Professor Cope.

The following persons have recently qualified themselves for the position of privat-docent: Dr. Alfred Bergeat for geology in the University of Munich; Dr. René Du Bois Reymond for physiology in the University of Berlin; Dr. A. Landauer for physiology in the University of Budapesth; Dr. Franz Nissl for anatomy in the University of Heidelberg; Dr. Heinrich Sachs for anatomy in the University of Breslau.

Professor Johannes von Kries, of Freiburg, who was called to the chair of physiology in the University of Berlin, as successor to the late Professor Du Bois Reymond, has decided to remain in Freiburg.

Dr. Henri Filhol, professor of anatomy in the Museum of Natural History of Paris, has been elected to membership in the Academy of Sciences of Paris, as successor to the late Professor Sappey.

Dr. F. Saccardo, professor in the enological school at Avellino, and known for his studies of lichens, died Oct. 6, 1896, aged 27 years. He was a nephew of Dr. P. A. Saccardo, the mycologist.

Dr. W. A. Rothert has been advanced to the position of professor extraordinarius of botany in the University of Kazan, and Dr. O. Seeliger to the chair of zoology in the University of Berlin.

Dr. Beer has qualified as privat-docent in comparative physiology in the University of Vienna, and Dr. R. Krause as privat-docent in anatomy in the University of Berlin.

Among other recent deaths we notice those of S. Scholz-Rogozinski, African traveler; P. Briard, mycologist; A. S. Smith, ornithologist, and Dr. G. W. Child, botanist.

Professor Karl Alfred von Zittel, professor in paleontology in Munich, has been elected corresponding member of the Academy of Sciences in St. Petersburg.

Dr. J. A. Oudemanns has resigned his position as director of the Botanical Gardens at Amsterdam, and Dr. Hugo de Vries has been appointed as his successor.

The government of the Transvaal, South Africa, is about to establish a University at Pretoria. Instruction will be given in the Dutch language.

The Royal Academy of Sciences, in Berlin, has elected Professor E. H. Ehlers, of Göttingen, to associate membership in the class of zoology.

Prof. B. C. Brühl, for nearly forty years professor of anatomy in the University of Vienna, has resigned and removed to Gratz.

S. Flower, the son of Sir W. H. Flower of the British Museum, has gone to Bangkok as director of the Royal Museum of Siam.

Dr. O. Penziz, professor of botany in the University of Genoa, has gone on a long trip for botanical study in the East Indies.

Miss A. M. Claypole has been appointed instructor in zoology, and Miss J. Evans instructor in botany in Wellesley College.

Dr. G. Dewalque, professor of physical geography and geology in the University of Liege, has resigned on account of age.

The Academy of Sciences of Paris has elected the mineralogist Gustav Tschermak, of Vienna, to corresponding membership.

Dr. H. G. Hallier has resigned his position in the Botanical Station at Buitenzorg, Java, and has returned to Germany.

Prof. M. Schiff, who occupied the chair of physiology in the University of Geneva, died Oct. 6, 1896, at the age of 73.

The director of the Bacteriological Institute of the University of Vienna, Dr. R. Kerry, died Oct. 19, 1896.

W. Whitaker, for forty years district surveyor of the Geological Survey of England, has resigned his position.

Dr. Rudolf Schäfer has resigned his position as custodian of the paleontological Collections in Munich.

Professor Alfred Hughes, of the chair of anatomy in the University College, Cardiff, Wales, has resigned.

Professor W. Kühne, of Heidelberg, has refused a call to Berlin, as a successor to Du Bois Reymond.

Dr. F. Graeff, of Freiburg, i. B., goes to the University of Breslau as professor extraordinarius of mineralogy.

Dr. F. von Müller, government botanist at Victoria, died at Melbourne, Oct. 9, 1896, aged 71.

Dr. Müller has resigned his position as director of the Zoological Gardens at Königsberg, i. P.

Dr. J. A. Moloney, the African traveler, died in Surtiton, So. Africa, Oct. 5, 1896, aged 36 years.

F. A. Hazslinsky de Hazlin, the nestor of Hungarian Botanists, died in Eperjes, Nov. 19, 1896.

Dr. Teodoro Caruel, professor of botany in the University of Florence, has retired.

Prof. A. Negri, geologist and paleontologist of Padua, committed suicide Dec. 11, 1896.

Prof. A. Batalin, director of the Botanical Garden at St. Petersburg, died Oct. 15, 1896.

Sir B. W. Richardson, histologist, died in London, Nov. 21, 1896, aged 68 years.

E. C. Thurber, ornithologist, died September 6, 1896, at Alhambra, California.

Thomas Egleston, Professor of Mineralogy in Columbia College, has resigned.

A. Trecul, botanist, of Paris, died Oct. 17, 1896, at the age of 70.

The following important announcement is extracted from a private letter just received by the Managing Editor pro tem. of this journal from Prof. Th. Tschernychew, and relates to regulation of the Committee of Organization of the International Geological Congress by which it would be well for all universities and scientific societies to profit. The translation follows:

International Geological Congress,
7th Session, 1897.
St. Petersburg, April 3, 1897.

Honored Sir:—In answer to your letter of the 25th of March I have the honor to announce that all Scientific Societies which inscribe themselves members of the Congress will receive its publications. The bureau considers it a duty to thank you for having distributed its circulars to geologists in America, and to inform you that from this time on the number of persons who have inscribed themselves is so great—nearly 700—that it will be absolutely impossible to enable them all to take part in the excursions.

As to the delegates of the different scientific institutions, the Committee of Organization, desiring to follow the precedent established by former Congresses, hopes that each of those institutions which desires to have itself represented by a delegate will not fail to announce his name in advance.

Accept the assurance of my most distinguished consideration.

TH. TSCHERNYSCHEW.

DR. PERSIFOR FRAZER,
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Learned societies and other similar bodies which desire to profit by this permission, should address Mr. A. O. Michalski, Comité Géolgique, St. Petersburg, Wassili Ostrow. 4^{me} ligne, enclosing a draft for twenty-two francs and specifically stating the name of the Society which wishes to be inscribed a member of the Congress, and also that in addition to the twelve francs which are sent as membership dues, ten francs are added for the livret guide (which will contain very valuable information).—P. F.

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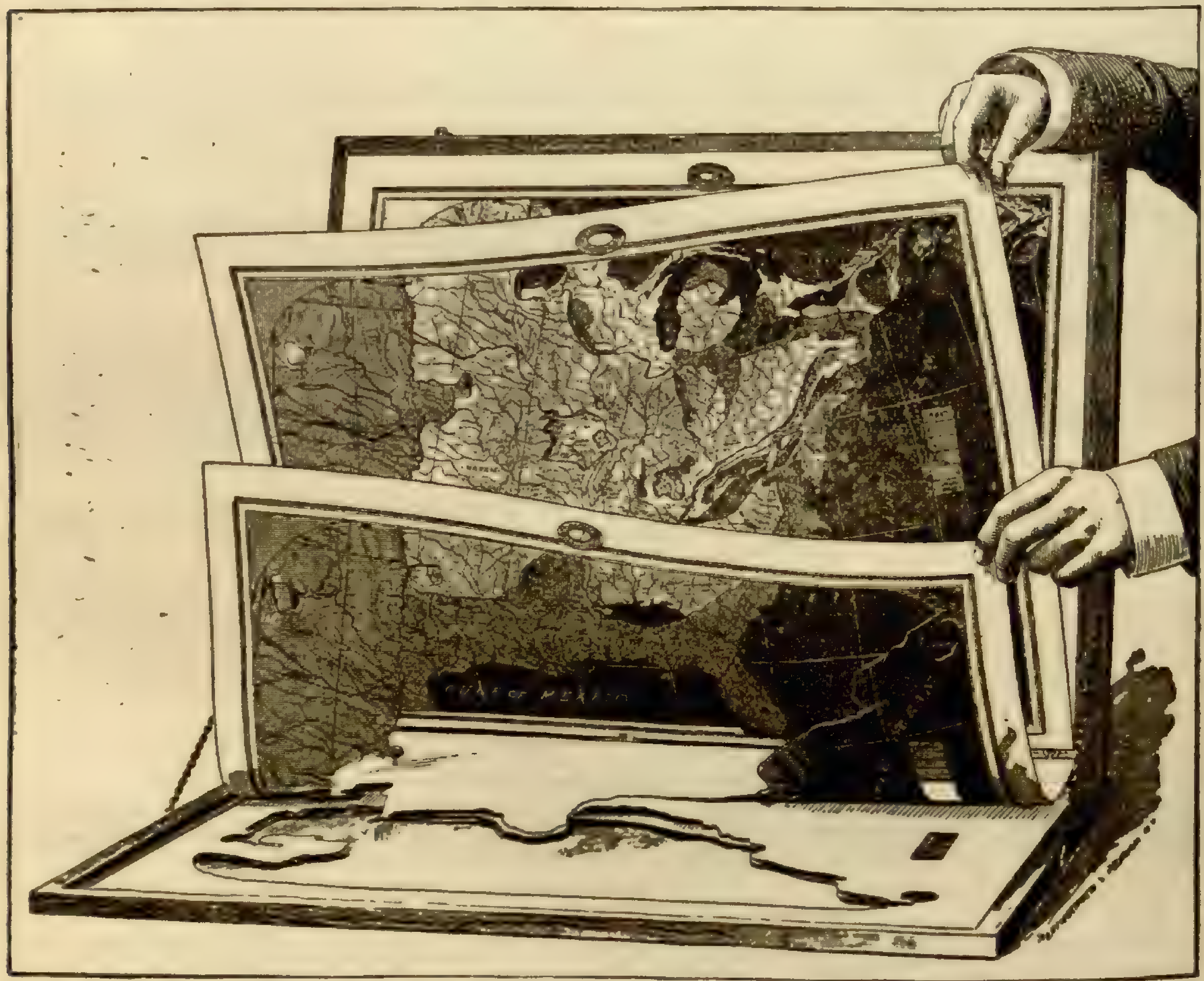

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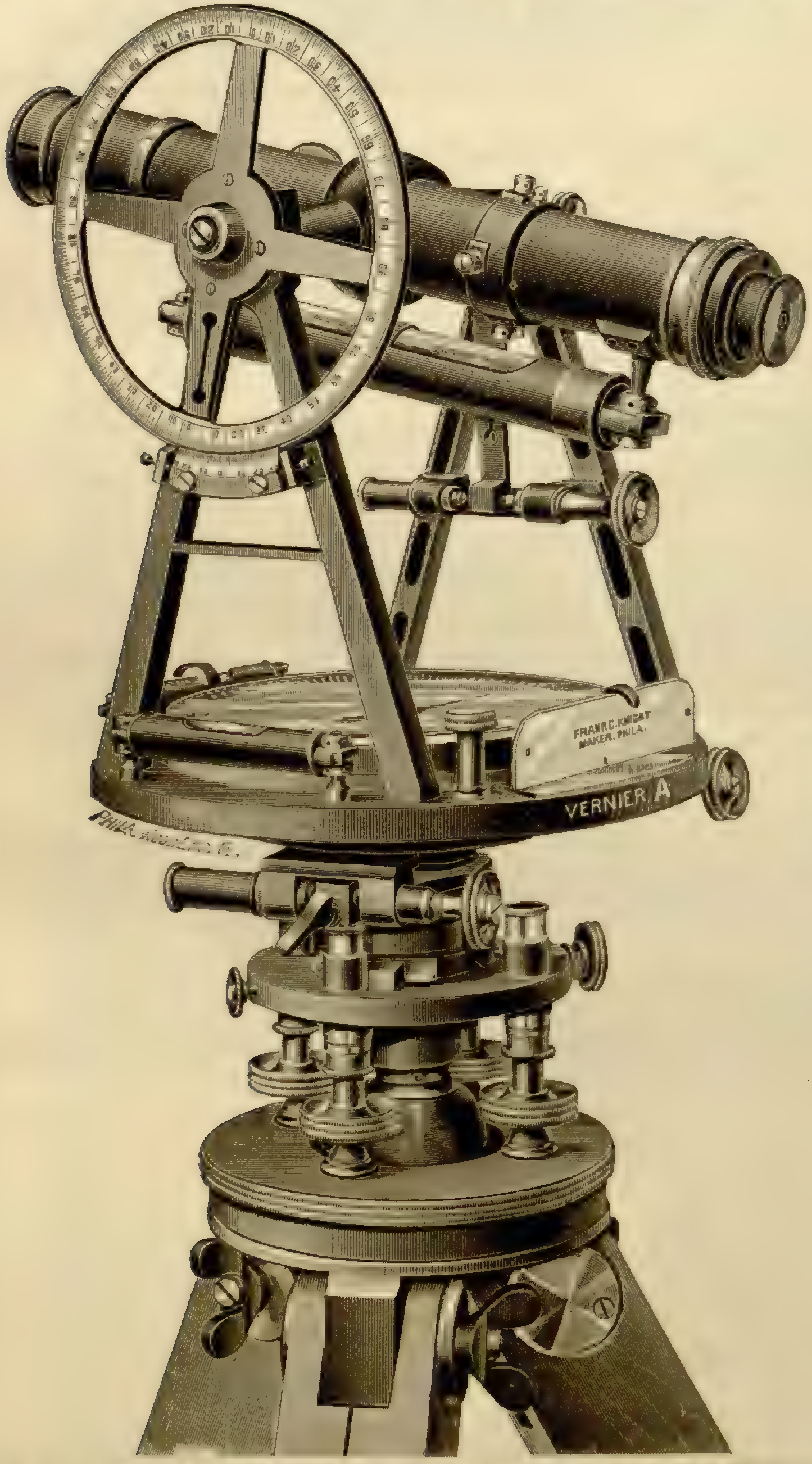
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THE

AMERICAN NATURALIST

VOL. XXXI. June, 1897. 366

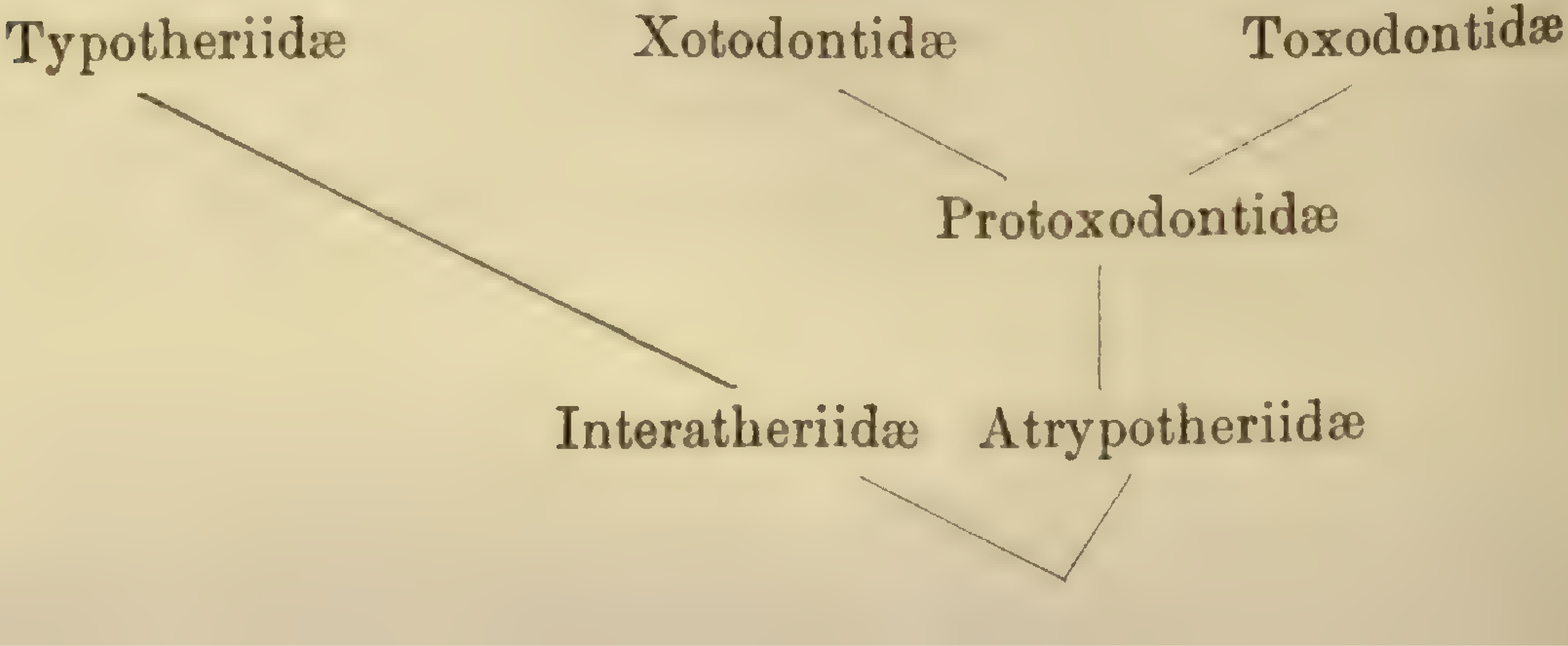
TOXODONTIA.

By E. D. Cope.

In this order of Ungulates the carpus is partly diplarthrous, while the tarsus is taxeopodous. The carpus is quite like that of the Amblypoda, the scaphoid bone not extending external to the trapezoides, while the lunar has a well-marked articulation with the unciform. The tarsus, on the other hand, is like that of the Taxeopoda in general, but adheres strictly to the Ungulate type in the truncate and non-moveable articulation of the astragalus with the succeeding element, the navicular. The ungues vary from broadly to narrowly ungulate; as in Toxodon they resemble those of a rhinoceros, and in Typotherium those of some of the subungulate Glires, as the Capybara. The known members of the order are plantigrade, or nearly so. In all of them the fibula articulates with the calcaneum. In some of them there is no clavicle, while in others it is present. The dentition is lophodont, becoming ptychodont in some of the later forms; quadri- and tritubercular forms being unknown. In details the families and genera differ much among themselves. I therefore consider the further characters under the respective heads. I adopt the system of Ameghino, which seems to express their affinities very closely.

I. Some or all of the molars rooted.
A. Last inferior premolar at least with four roots.
Incisors with simple closed roots; *Atryptheriidæ.*
AA. Inferior premolar with two roots.
Incisors with simple closed roots, and no enamel; *Interatheriidæ.*
Several incisors with open roots and an anterior enamel band as in the Glires; other incisors with closed roots; *Protoxodontidæ.*
II. Molar teeth with simple open roots.
A. Inferior molars curved outwards.
Enamel covered by cement; *Typotheriidæ.*
Enamel exposed; *Xotodontidæ.*
AA. Inferior molars curved inwards.
Enamel not covered by cement; *Toxodontiidæ.*

The skeleton is best known in the typical genera of the families Typotheriidæ and Toxodontidæ. In Typotherium there is a clavicle, and the femur has a third trochanter. The sacrum is elongate, including nine vertebræ, and the ischium articulates with the posterior of these, as the ilium does with the anterior. In Toxodon there is no clavicle, the femur has no third trochanter, and the ilium only articulates with the sacrum, which consists of five vertebræ. In both genera there is a central bone of the carpus. According to Ameghino, the families with rooted molars are of prior geologic age to those with the prismatic type with open roots. This succession is parallel to the history of the families of the Glires and the Diplarthra. The following table of affinities and phylogeny is given by Ameghino:—



The molar teeth in this order are furnished with enamel over the summit of the crown, and in bands on its shaft, when present. In the superior molars there is a longitudinal exterior wall, and from one to three more or less oblique transverse crests running inwards from it, when the crowns are not entirely simple. The summit of the crown is soon worn away and the tooth then displays the pattern of a transverse section. The inferior molars are much narrower than the superior, and have several lobes on the internal side (in section). The incisors are more or less specialized towards gliriform types in the later genera. The canines are always small when present.

There are but two certainly known genera of ATRYPTHERIIDÆ, which differ as follows :—

Pm. $_{\overline{4}}$ with four roots; two molars with open roots; an inferior canine; *Atryptherium* Amegh.

Pm. $_{\overline{3}}$ and $_{\overline{4}}$ and m. $_{\overline{1}}$ with four roots; m. $_{\overline{3}}$ and m. $_{\overline{4}}$ with open roots; no inferior canine; *Scopotherium* Amegh.

Each of the above genera contained but a single species of about the size of a tapir, from the Eocene beds of Patagonia. The genus Nesodon Owen from the same region and horizon may be identical with Scopotherium, according to Ameghino, but the structure of the roots of the inferior molar is unknown. Two species are known, *N. ovinus*, the size of a sheep, and *N. imbricatus* Ow. as large as a tapir. In all of these forms the incisors are not much specialized, but are subequal.

In the INTERATHERIIDÆ the incisors are still unspecialized in the gliriform direction, and their roots are conic and closed. The four genera differ as follows :—

I. Pms. $^{\underline{2}}$ and $_{\overline{2}}$ with distinct roots. Incisors diminishing in size externally; *Interatherium* Moreno.

II. All molars rootless and open.
  Pm.$_{\overline{3}}$ and $_{\overline{4}}$ consisting of two subequal columns; incisors diminishing outwards; *Icochilus* Amegh.
  Pm. $_{\overline{3}}$ and $_{\overline{4}}$ of two columns, the anterior much larger than the posterior; external incisor with expanded crown, which is bilobate on the internal side; *Protypotherium* Amegh.

Like Protypotherium, but all the inferior incisors with expanded crown, which is bilobate on the internal side;
Patriarchus Amegh.

All the genera and most of the species of this family have been derived from the Eocene beds of Patagonia. One species of Protypotherium has been found in the Oligocene of the same region, and another species of the same genus in the Miocene of Buenos Ayres.

There are two species of Interatherium which were about the dimensions of hares and rabbits. The four species of Icochilus and the five of Protypotherium ranged from the size of our *Lepus silvaticus* up to that of a fisher weasel or a little larger. The single Patriarchus, *P. paluridens* Amegh., rather exceeded the latter animal. Its incisor teeth are peculiar in their expanded crowns, with a deep longitudinal groove on the internal side.

The genera and species of the PROTOXODONTIDÆ are all from the Eocene beds of Patagonia, with one uncertain exception. The former differ as follows, according to Ameghino:—

I. Molars with base more or less rooted, and with crown with unequal lobes.
α Superior incisors regularly diminishing outwards.
Molars with imperfect roots and open base;
Adelpbotherium Amegh.
αα Second incisor largest and with open base; I. 3 rudimental or small.
β I. 1 present.
Eight superior molars; *Acrotherium* Amegh.
Superior molars 7; first inferior premolar one-rooted;
Adinotherium Amegh.
Superior molars 7; Pm. $\frac{1}{}$ and $\frac{2}{}$ one-rooted;
Protoxodon Amegh.
β β I. 1 wanting.
I. $\frac{2}{}$ triangular in section; *Phoberotherium* Amegh.
II. Inferior molors rooted and with opposite lateral grooves.
Anterior column of molars smaller than posterior;
Calpodon Burm.

III. Inferior molars rootless and with open base, and with opposite lateral grooves. Anterior columns smaller than posterior; shaft curved inwards; *Gronotherium* Amegh.

Where the feet are known in this family, they exhibit three digits anteriorly and three posteriorly, which is remarkable in genera of such early age (Acrotherium, Adinotherium and Protoxodon). The possession of eight molars by Acrotherium is a remarkable fact, and one which reminds us of the Sirenia, to which Owen thought the Toxodontia to be allied. Ameghino regards them as representing five premolars and three true molars.

The species of the above genera were of various dimensions, but generally exceeded those of the Interatheriidæ. The smallest is the *Colpodon limitatum* Amegh., which does not exceed a rabbit, but other species equaled deer in dimensions, and the *Protoxodon sullivanii* of Owen and *Acrotherium rusticum* Amegh. reached the size of the ox.

In the increased development of the second incisor an approach to the Toxodontidæ is seen, and the same tendency is exhibited in the open rooted and incurved crowns of the true molars in Gronotherium. Fifteen species of the family are known, of which four belong to Protoxodon and five to Adinotherium.

Taking up another line of departure from the Interatheriidæ, we reach the TYPOTHERIIDÆ, one of the two principal types by which the order Toxodontia was represented at the time of its extinction at the end of the Pliocene. We find here a great specialization of the first incisors in both jaws, and a gradual extinction of the third and second, so that in Typotherium this part of the dentition is decidedly gliriform, so much so that some authors have placed this family in the order Glires. In the oldest genus (Hegetotherium Amegh.) the molars are simple and of oval section, while in the latest forms they are lophodont with an external longitudinal and internal transverse crests, as in most other forms of the order. The genera differ as follows:—

I. Superior molars without folds or columns.

Incisors $?\frac{3}{3}$; molars $\frac{7}{7}$ *Hegetotherium* Amegh.

Incisors $\frac{1}{2}$; molars $\frac{6}{6}$; *Pachyrhucus* Amegh.
II. Superior molars with three internal lobes.
Incisors $\frac{3}{}$; molars $\frac{5}{}$; *Trachytherus* Amegh.
Incisors $\frac{1}{3}$; molars $\frac{5}{4}$; *Entelomorphus* Amegh.
Incisors $\frac{1}{2}$; molars $\frac{5}{4}$; *Mesotherium* Serres.

These genera are distributed as follows:—

Hegetotherium: two species from the Lower Eocene.

Pachyrhucus: five species Lower Eocene, four species Miocene, one species Inferior Pliocene.

Trachytherus: one species Lower Eocene.

Entelomorphus: One species Inferior Pliocene.

Mesotherium: four species Upper Miocene, four species Lower Pliocene, three of them found also in the Upper Miocene.

A clavicle is present in Pachyrhucus and Mesotherium, and may be expected to be discovered in the other genera of this family. The dental canal sends out a branch which issues from the ramus posteriorly on the external side. According to Ameghino this character is not present in other families of the Toxodontia.

Most of the species were of small or medium size, and probably resembled the conies in their appearance and habits. *Mesotherium cristatum* Serres, and *Trachytherus spegazzianus* Amegh. reached the size of the tapir.

In the XOTODONTIDÆ of Ameghino we have a family which presents characters of both the families Mesotheriidæ and Toxodontidæ. As in the former, the inferior molars turn outwards below, but they are not covered with cementum as in that family. The known genera have the dental series uninterrupted, thus displaying a more primitive character than most of those of the two families mentioned.

The genera are as follows:—

I. Incisors entirely covered with enamel. Incisors and molars with open base; latter not plicate; *Entomodus* Amegh.
II. Incisors with enamel bands only.
α Molars $\frac{}{1}$ and $\frac{}{2}$ trilobate internally and bilobate externally. All inferior premolars curved outwards; *Xotodon* Amegh.

Inferior molars turned inwards and true molars turned outwards; *Stenostrephanus* Amegh.

αα Molars $_1$ and $_2$ bilobate externally and internally. M. $_3$ trilobate on internal side, *Lithops* Amegh.

Of the six species of this family one of Lithops and one of Stenostephanus are from the Lower Eocene of Patagonia; and one of Entomodus, one of Xotodon and one of Stenostephanus are from the Lower Miocene of the same region; and one species of Xotodon is from the Upper Miocene of Buenos Ayres.

The TOXODONTIDÆ includes the latest of one of the two lines of descent of this order. The genera differ in the forms of the molar teeth, and some of them show a decided simplification of structure which must be regarded as a degeneracy. Most of the species are of large size. Toes three, both in front and behind. The genera differ as follows:—

I. Seven superior molars.

Superior molars with internal groove and column of moderate size; *Toxodon* Owen.

Superior molars with internal groove and very large internal column; *Toxodontotherium* Amegh.

Superior molars without internal groove or column; *Haplodontotherium* Amegh.

II. Six superior molars.

Pm. ^{4} and true molars with two internal grooves; *Dilobodon* Amegh.

Pm. all simple; m. with one internal groove; *Trigonodon* Amegh.

Seventeen species of this family have been determined up to the present time, eleven of which belong to the genus Toxodon. Two species each are referred to Toxodontotherium and Dilobodon, and one each to the two remaining genera. The geological distribution of these species is as follows:—

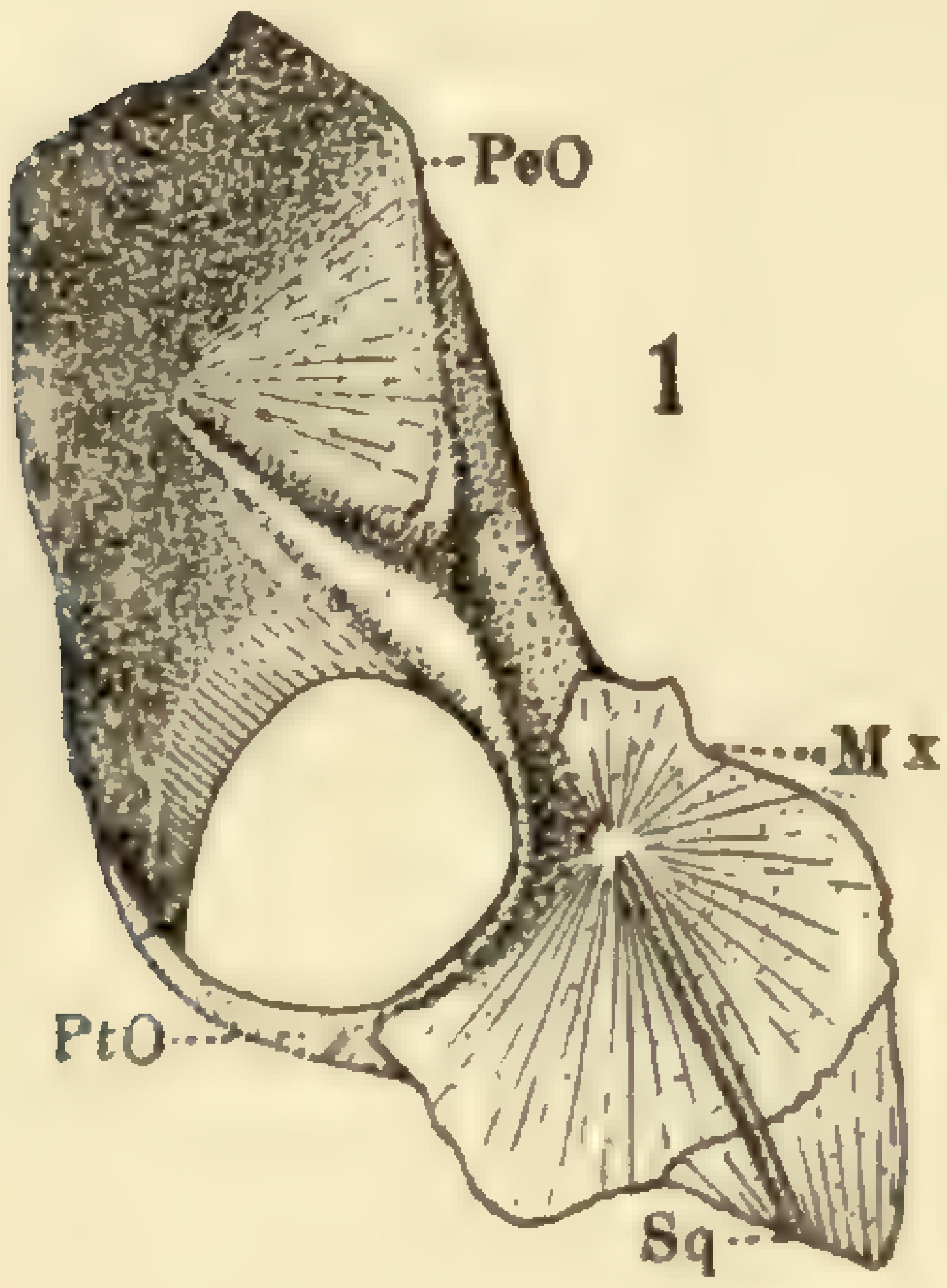
	Oligocene.	Miocene.	Pliocene.
Toxodon,	3	1	7
Toxodontotherium,	1		
Haplodontotherium,	2		
Dilobodon,	1		1
Trigonodon,		1	
	7	2	8

The incisor teeth display an increased specialization in the genera commencing with Trigonodon and ending with Toxodon. The dental formula in Toxodon is I. $\frac{2}{3}$; C. $\frac{0}{1}$; Pm. $\frac{4}{3}$; M. $\frac{3}{3}$; in Trigodon it is I. $\frac{3}{?3}$; C. $\frac{1}{1}$; Pm. $\frac{3}{3}$; M. $\frac{3}{3}$. In Trigonodon the median ($\frac{1}{}\ \frac{2}{}$) incisors are smaller and have closed roots, while the external is large and has open roots. In Toxodon the I. $\frac{1}{}$ has disappeared, and the I. $\frac{2}{}$ is extended transversely and has an open root. The I. $\frac{3}{}$ is narrower and more elongate and has an open root. The species of Toxodon differ as to the transverse extent of the I. $\frac{2}{}$; it being wider in the *T. burmeisteri* Gieb. than in the typical species, *T. platensis* Owen, and widest in the *T. expansidens* Cope from Brazil.

The skull of Toxodon is wide and elevated posteriorly and narrow anteriorly. The occiput slopes anteriorly and is notched on each side by a large mastoid foramen, somewhat as in the Sirenia. The nostrils have a posterior position. For these reasons it has been suspected that there may be some affinity between the Toxodontia and the Sirenia.

The species of Toxodon were, according to Ameghino, heavy animals with rather short legs, the anterior the shorter. He imagines that they were shore dwellers or semi-aquatic, in some degree like the Hippopotamus in their habits. The *T. platensis* Ow. is about the size of the *Rhinocerus unicornis;* the *T. burmeisteri* is somewhat larger, while the *T. ensenadensis* is of still larger dimensions. The *Toxodontotherium compressum* Amegh. was of about the size of the typical Toxodons, while the species of the other genera of the family are of successively smaller size, those of Dilobodon being the least.

PLATE XII.


PeO
1
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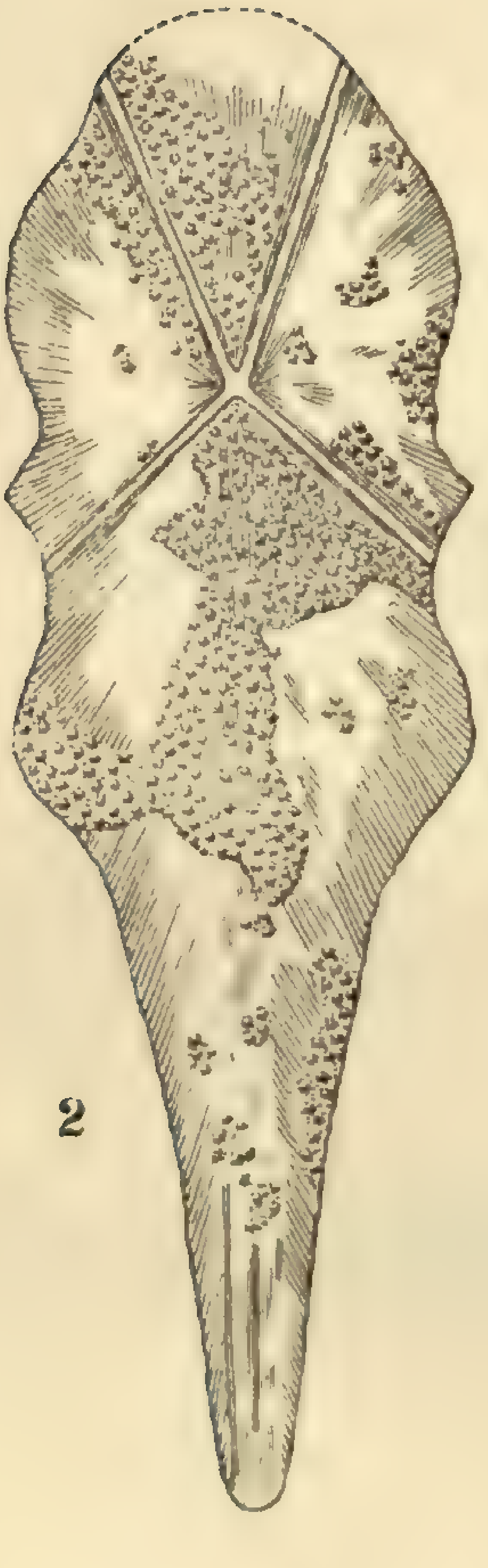

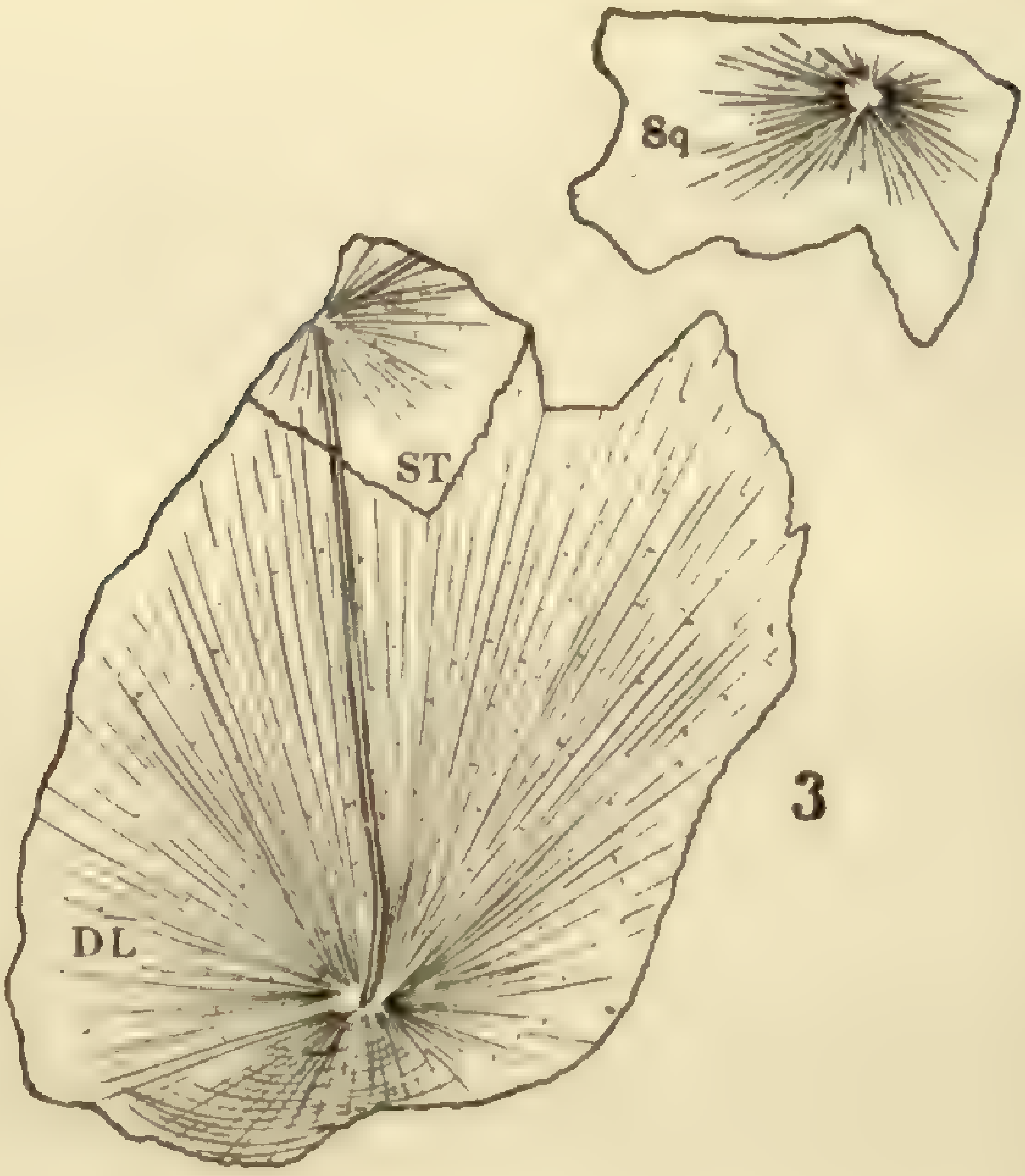

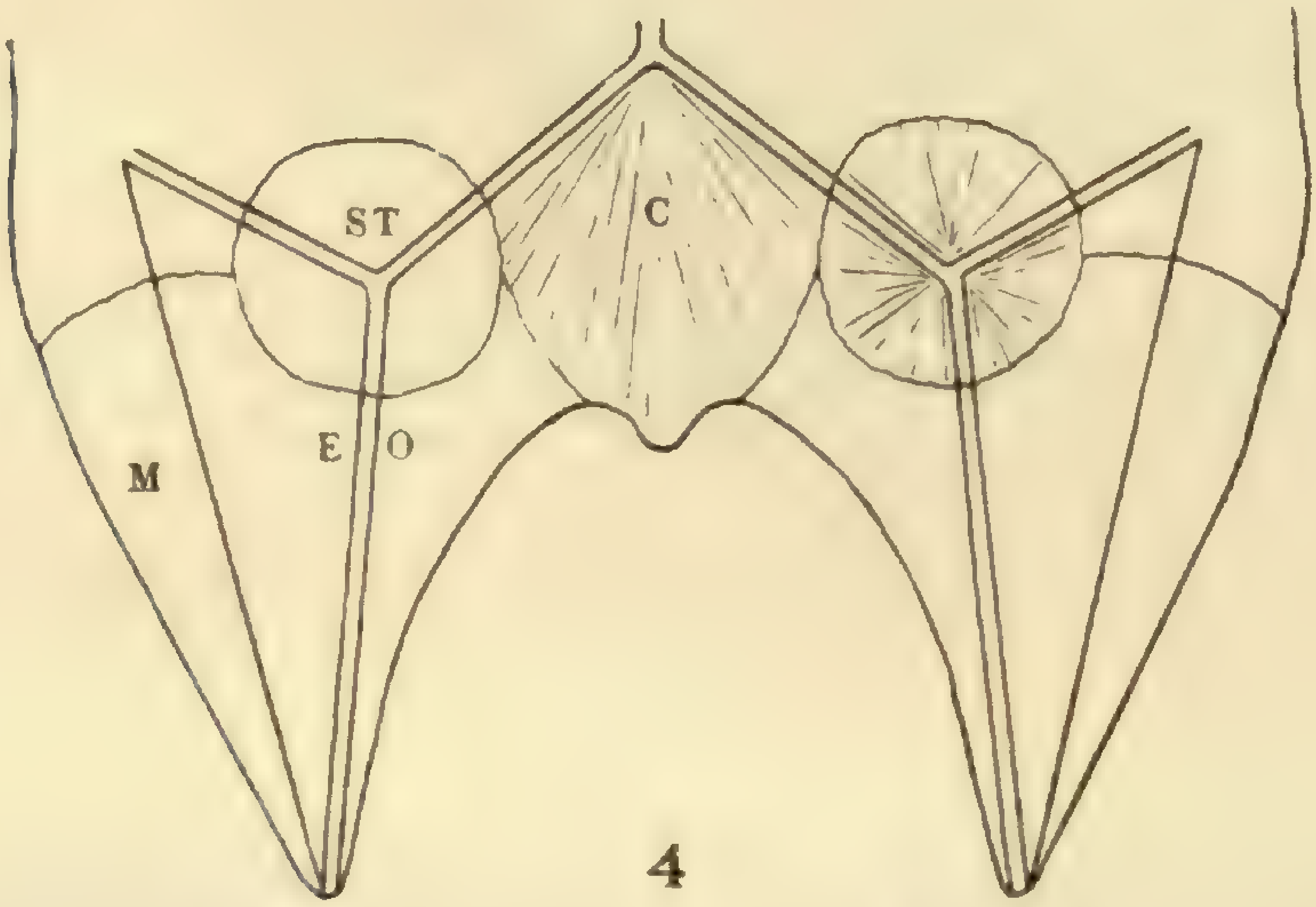

J. W. Folsom.

Macropetalichthys sullivanti Newberry.

ON THE CHARACTERS OF MACROPETALICHTHYS.

BY C. R. EASTMAN.

Although crania of *Macropetalichthys* have been known for more than sixty years, and have been frequently figured and described, the genus remains one of the most enigmatical of Palaeozoic fishes. Notwithstanding its abundance and generally excellent state of preservation, circumstances which are conducive toward a comparative investigation, we have as yet only a superficial knowledge of its structure. In fact, it would not be exaggerated to assert that none of our Devonian fishes have been so completely misapprehended and erroneously described as *Macropetalichthys.* This will hardly be disputed when we recall the disagreement concerning the number of species, and the fact that they have been described under no less than five different generic titles. It is further true that sensory canals have been almost invariably mistaken for sutures, and comparisons essayed on the basis of an imaginary osteology; a structure altogether distinct from the head shield, and separated from it by a bony wall, was mistaken for the "cerebral chamber" (Newberry); a pineal foramen is stated by all observers to be absent; and the osteology of the most familiar species, *M. sullivanti,* is still a *regio incognita.*

The only species in which the arrangement of cranial plates has been worked out with any degree of accuracy is that recognized as the type of the genus, *M. rapheidolabis.* The original description of this species by Norwood and Owen[1] is very imperfect. Newberry,[2] who examined a cast of the type specimen, elicited no new information regarding it; and it was reserved for Cope,[3] as late as 1891, to redescribe the type specimen as satisfactorily as its mutilated condition would permit. This historic fossil, it is sad to relate, has since been destroyed by fire. Cope also described in the same article a specimen of *M.*

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[1] Amer. Jour. Sci. [2], Vol. I, (1846), pp. 367–371.

[2] *Ibid,* Vol. XXXIV, (1862), p. 76.

[3] Proc. U. S. Nat. Museum, Vol. XIV, (1891), pp. 449–456.

sullivanti, which was weathered in such a manner as to reveal the under surface of the head. Reference will hereafter be made to this description, which is in every way a notable one, and the cranium on which it was based. For an opportunity of studying the latter, together with other valuable specimens preserved in the museum of Ohio State University, the writer is greatly indebted to Dr. Edward Orton.

Besides these specimens, the writer has examined a large amount of material belonging to different public and private collections, and is thus enabled to supply certain deficiencies in our knowledge of the leading species *M. sullivanti.* Only a brief exposition of the cranial characters can be attempted within the limits of the present article, a more detailed discussion being reserved until another time.

The cranium of *Macropetalichthys* is to be conceived as a comparatively thin, flexible box or capsule, capable of withstanding a good deal of distortion without rupture. It is composed of plates united by squamosal sutures, and traversed centrally by the sensory canal system. The posterior boundary of the cranium is deeply concave in the middle, and its postero-lateral angles are produced backwards for a considerable distance, over-riding a structure called by Cope the "nuchal plate." The elements taking part in these cranial prolongations are probably homologous with the epiotic and marginal plates of other Coccosteids; although no definite sutures have been observed between them, a marked depression occurs, extending from the extremity of the posterior angle forwards toward the centre of the squamosal plate, and this depression may represent the natural boundaries of the epiotic and marginal plates. This depressed line corresponds with the externo-lateral suture of Newberry's "parietal? plate," as represented in his diagram.[4] The externo-lateral boundary of his so-called "squamosal" is only the outer margin of the cranial prolongations just described; their inner margins have not been previously shown, but are represented in Pl. XII, fig. 4.

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[4] Palaeozoic Fishes of North America, (Monograph U. S. Geol. Surv.,Vol. XVI, 1889), p. 43.

Two facts furnish additional corroboration of the view that the posterior cranial angles are formed by plates homologous with the epiotic and marginal of other Coccosteids: first, the course of the sensory canal system, which traverses the center of the epiotic in a straight line backward until it emerges upon and penetrates into an element called by Cope the "nuchal plate;" and second, the reception of the postero-lateral angles of the cranium into a concavity on either side of the nuchal plate so that the latter becomes firmly articulated with the head shield. This mode of union between cranium and nuchal plate is, we believe, equivalent to the hinge-joint formed by the epiotic and antero-dorso-lateral in other Arthrodires. The logical conclusion of this view is that the "nuchal element" represents collectively the dorsal plates of the body, and is homologous with the dorso-median and dorso-laterals of other Coccosteid genera; hence it is more properly styled the *dorsal plate.*

The dorsal plate, as it will hereinafter be called, occurs as a distinct element immediately behind the cranium, from which it is partitioned off by a thin osseous membrane that forms a vertical wall in front, and slopes away under the posterior angles of the cranium on the sides. A thin layer of bony tissue covers the entire upper surface and also the posterior face, the latter corresponding to the cranial process in the Dinichthyids. The existence of this element was known to Newberry, who regarded it as a "cerebral chamber." Cope demonstrated the fallacy of this notion, and considered it as a prolongation of the median occipital region backward in order to protect the anterior part of the vertebral axis; and it was held that "such a structure would indicate the presence of a number of fixed vertebral elements, such as exists in the chimaeras, the rays and the sturgeons." This author correctly observes that there are "two angular elements on each side of the posterior region, which are also shown to be distinct. . . . One of these is wanting in the specimen, showing its junction with the median element is by a smooth squamosal suture."[5] These angular elements he calls the "lateral nuchal plates;" but it is patent from the specimen that they are only the posterior cranial angles, produced in the manner already described. One of them is preserved in its natural position, and the other, that belonging to the right side, has become dismembered and lost. The supposed "articular glenoid cavity, possibly for the condyle of a mandible," which is stated to be "one-half in the cranium and one-half in the nuchal element," pertains entirely to the head shield, and abuts directly against the cranial roof.

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[5] *Loc. cit.*, p. 453.

Turning now to the osteology of the back of the head, very peculiar conditions are encountered. The boundaries of the large central plate are readily determinable, and are about the same as Cope has shown for *M. rapheidolabis*.[6] Epiotic and marginal presumably constitute the postero-lateral angles. But superimposed upon the dorsal plate and hinder part of the cranium is a system of tuberculated derm plates which are arranged independently of the bones beneath. There is first of all a median superficial element which covers the same space as the central, but in addition to this it preserves its

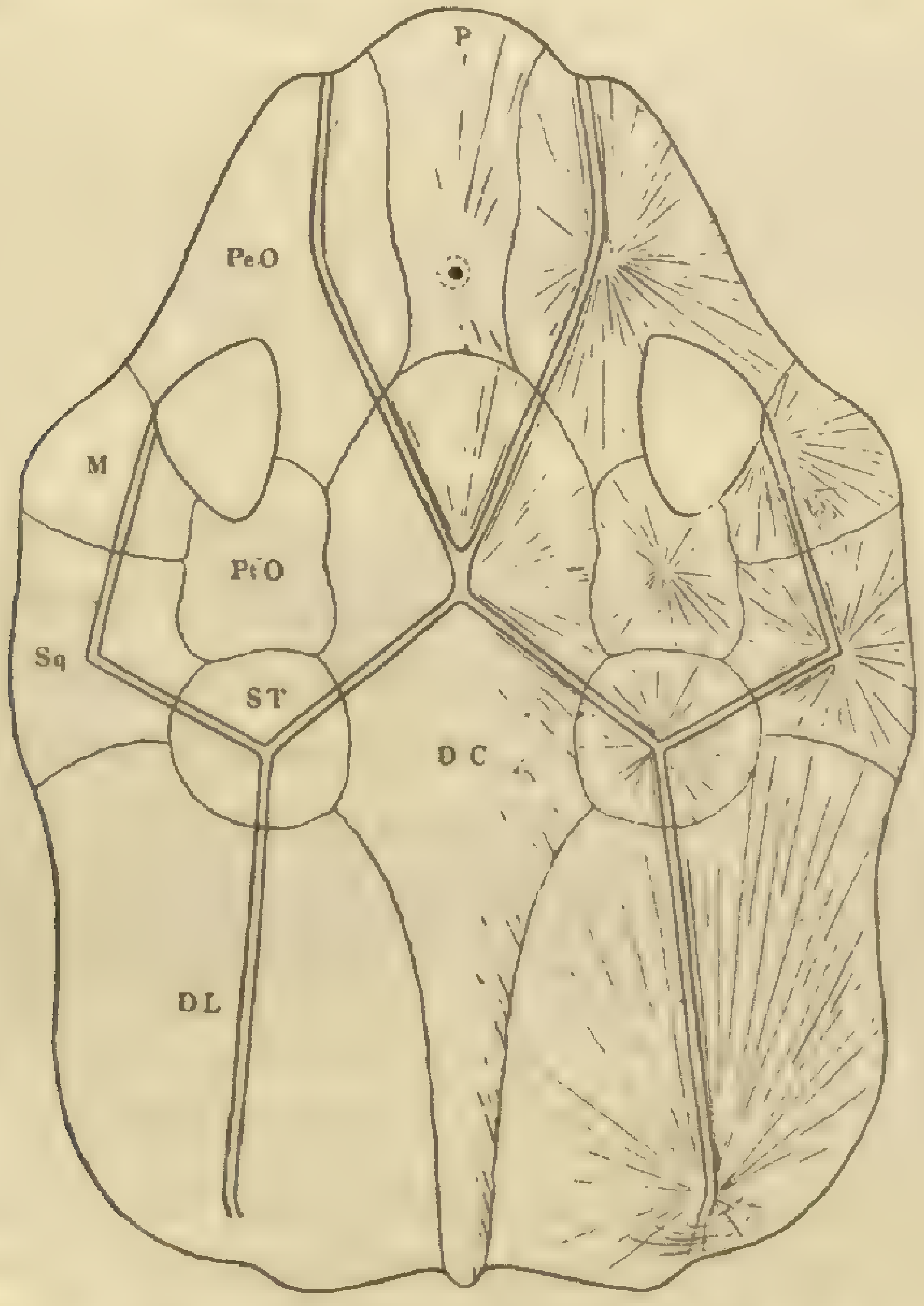

Fig. 5. *Macropetalichthys sullivanti* Newb. × ⅓.

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[6] *Loc. cit.*, pl. xxix, fig. 4.

continuity backward, gradually tapering as far as the hinder margin of the dorsal plate. That this is a coherent element by itself is proved by its occurrence in the detached condition; of several examples that have been met with, one is represented in Pl. XII, fig. 2. To distinguish it from other structures it may be called the *dorso-central.* On either side of the dorso-central is an apron-like expansion, which covers the remainder of the dorsal plate as far as its lateral margin, and incidentally conceals the posterior cranial angles. It is united with the dorso-central by sutures, and also with the plates in front of it in like manner. It, too, occurs in the detached condition, as is shown in fig. 3 (*DL*), and is worthy of being distinguished by a separate name. We propose to call it the *dorso-lateral.*

From the foregoing, it will be seen that portions of the cranium and also the dorsal element, to be regarded as a unit by itself, are covered by superficial scutes which are incapable of correlation with derm plates in other Arthrodires. Possibly they were originally coextensive with the underlying elements, which are now greatly reduced in thickness; afterwards they may have coalesced with one another and acquired a simpler, although still symmetrical arrangement. This condition is unparalleled among fishes, but a resemblance to it may be found in the corneous layer covering the carapace of turtles. The fact, however, that some of the tuberculated scutes no longer correspond with the subjacent elements, arouses a suspicion that the remaining scutes may present more or less modified conditions. It is to be noted that their arrangement differs from the pattern of most Arthrodires; but inasmuch as a separate system of plates has not been observed except in the posterior region, we may presume that in advance of this area each derm plate was covered by its own tuberculated coating.

The problem of determining homologies among the cranial plates is by no means an easy one. It is certain that the plate termed for convenience the "central" corresponds to much more than the like-named element in other Coccosteids; in it are included at least the median occipital, the parietals and frontals, as these are recognized in *Dinichthys*, and the inference is that fusion has taken place more or less extensively among the remaining plates. That the median series should consist of but two plates, central and pineal, appears quite remarkable. As names have already been applied to the system of paired plates by Cope, it appears advisable to retain them, not because all of them express undoubted homologies, but merely for convenience of distinction. If this author has delineated the boundaries of the maxillary plate correctly in *M. rapheidolabis*, we have here a marked difference between the type-species and *M. sullivanti*.

A small pineal foramen occurs at a point about half-way between the frontal lyra formed by the sensory canals and the extremity of the muzzle. Its position is indicated in the cranium figured by Newberry,[7] although no significance was attributed to the structure there shown. The opening appears to be capped by a small operculum as in *Titanichthys*. Traces of a pineal foramen are also observable on a weathered specimen for which von Koenen[8] has established a new genus, *Holopetalichthys;* but as the configuration of the cranium agrees essentially with that of *Macropetalichthys* (*cf.* fig. 4), and is from an equivalent horizon, we venture to regard *H. novaki* as pertaining to the latter genus.

A description of the osteology in detail, including the inferior structure of the cranium, is beyond the scope of the present paper. It is hoped, however, that the diagrams given herewith will suffice to show the general arrangement of the cranial bones as they appear on the dorsal surface. The writer desires in conclusion to acknowledge his especial indebtedness for the loan of specimens to the following persons: Dr. Edward Orton, Director of the Ohio Geological Survey; Prof. A. A. Wright, of Oberlin College; Prof. R. P. Whitfield, of the American Museum of Natural History; Prof. J. F. Kemp, of the Columbia School of Mines; Prof. C. H. Hitchcock, of Dartmouth College; and Mr. F. K. Mixer, Curator of the Buffalo Society of Natural Sciences.

Museum of Comparative Zoology, Cambridge, Mass.

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[7] Palaeozoic Fishes of North America (Monograph U. S. Geol. Surv., Vol. XVI, 1889), pl. xxxviii, fig. 1.

[8] Abhandl. Göttingen Gesellsch. Wissen., Vol. XL, (1895), pl. iv, fig. 2.

EXPLANATION OF FIGURES.

PLATE XII.

Fig. 1. Fragment showing plates surrounding the left orbit, seen from the inside. Original in the American Museum of Natural History, New York (Cat. No. $\frac{4261}{1}$). Corniferous limestone, Delaware, Ohio.

Fig. 2. Detached dorso-central plate, from Lime Rock, Genesee County, New York. Original in Agassiz Museum, Cambridge, Mass. (M. C. Z., Cat. No. 1428).

Fig. 3. Fragment showing three detached plates of the left side, seen from the visceral aspect. Original in Museum of Oberlin College (*M.* No. 10). Corniferous limestone, Sandusky, Ohio.

Fig. 4. Diagram showing posterior cranial angles after removal of the dorsal ("nuchal") element and superjacent scutes.

Fig. 5. Diagram showing arrangement of plates and course of sensory canals in *Macropetalichthys sullivanti*, × $\frac{1}{3}$. Vascular canals indicated by radiating lines on the right side only (*cf.* Newberry's wood-cut, *Annals of Science*, 1852, No. 1, p. 12).

Plate figures reproduced two-thirds natural size. Sensory canals in figs. 1 and 3 are rendered more conspicuously than they appear on the specimens.

Lettering for all figures as follows:

C, Central.
DC, Dorso-central.
DL, Dorso-lateral.
EO, Epiotic.
M, Marginal.
Mx, Maxillary ("malar" Cope; "suborbital" Newberry).
P, Pineal.
PeO, Preorbital.
PtO, Postorbital.
Sq, Squamosal.
St, Supratemporal.

THE GOLDEN-EYE OR LACE-WING FLY.[1]

BY CLARENCE MOORES WEED.

Throughout the summer there may commonly be found upon the leaves of a great variety of plants, especially those infested by aphides of plant lice, groups of peculiar little vertical stalks tipped with small, oval, whitish bodies (Fig. 1 *a*). Should you be able to watch one of these groups for some time you would be likely to see a curious little larva hatch from each of the eggs—though the time of hatching is likely to vary, some emerging from the eggs considerably before the others.

The larvæ that have thus been cradled in the air are called aphis-lions, from their habit of feeding upon aphides. Soon after hatching they wander over the plant in search of prey, for which purpose almost any small insect will serve, but aphides generally form the principal item in the daily bill of fare. The aphis-lion has a formidable pair of jaws projecting forward from the head, so constructed that each jaw is a hollow sucking tube as well as an organ for seizing and piercing the victim.

Like other larvæ the aphis-lions cast their skins occasionally as they increase in size. They become fully developed after a few weeks, and are then nearly an inch long, and of the form shown in *b* and *d* of the figure. The different species vary considerably in color, but most are of more or less mottled shades of blue, brown, black and white. The presence of the sucking-tube in the jaw is explained when one examines the insect under the microscope, and finds that the mandible or jaw proper is grooved longitudinally on its inner surface, while the maxilla or secondary jaw is grooved longitudinally on its outer surface: these fit together so that the groves form a tube, through which the juices of the victims may be sucked into the stomach.

The fully developed larva prepares for the change to the pupa by rolling itself together compactly, and then spinning from the posterior end of its body a spherical silken cocoon, so small that one can but wonder how so large a larva stays inside it. The completed cocoon (*c*) is about the size of a small smooth pea, of a pearly white color, generally mottled in places with black (*e*). Within this tiny ball the larva becomes a pupa, and a short time afterwards changes into an adult, which gnaws out a circular cap and escapes.

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[1] From *Stories of Insect Life*, Grim & Co., 1897.

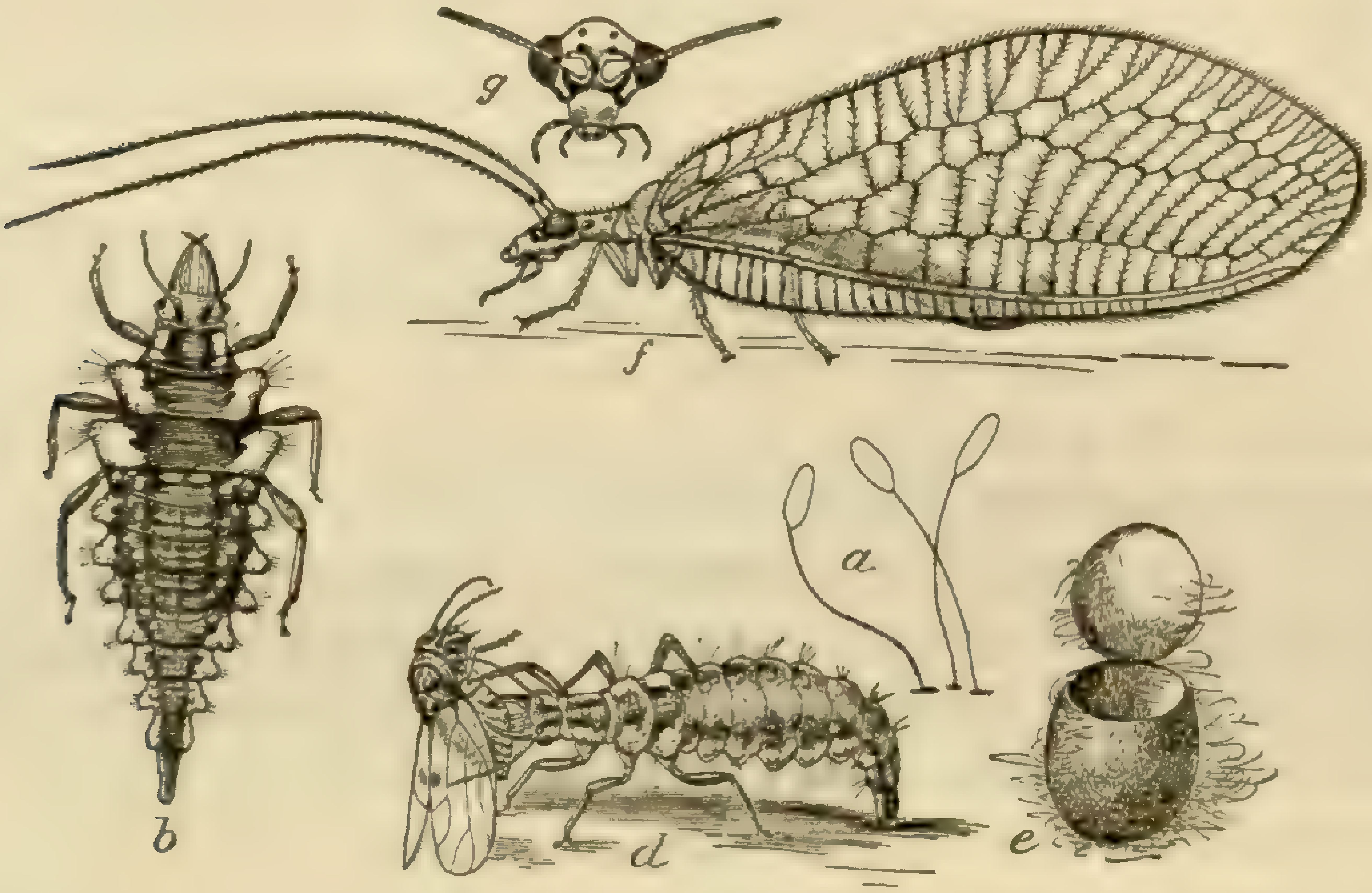

FIG. 1. *Chrysopa oculata.* *a*, eggs; *b*, full-grown larva or aphis-lion; *d*, larva devouring an adult psylla; *e*, cocoon; *f*, adult insect; g, front view of the head of the adult—all enlarged. (Reduced from figure by U. S. Dept. of Agr.)

The adult is a very different insect from the larva. It is a delicate-looking creature, a little over half an inch long, of a pale green or bluish-green color, with beautiful golden eyes standing out prominently on the sides of the head, which bears too long slender feelers or antennæ, that under a lens are seen to be furnished with numerous fine hairs. The first segment behind the head—called the prothorax—is wide and flattened; it bears a single pair of legs. The two following segments—the mesothorax and metathorax—are much larger and closely united; each bears a pair of wings above and a pair of legs below. The legs are rather long and slender, of much the same color as the body; the feet are tipped with two recurved claws. The wings are very large in proportion to the body; they consist of a thin, transparent membrane, stretched between a beautiful net-work of delicate greenish veins, which bear rows of brownish hairs. The front and hind wings are quite similar in shape, the hind ones being somewhat smaller; when at rest the insect folds them in a nearly vertical position (*f*), so that they project some distance beyond the end of the abdomen, which is slender and sparsely covered with hairs.

The female Lace-wings deposit their eggs on the long stalks already mentioned. The stalk is drawn out from a liquid secretion which hardens on exposure to the air, and the egg is then glued on to the tip. By thus placing the eggs up above the leaf surface the insect prevents their being eaten by lady bird beetles and other predaceous creatures, including the aphis-lions themselves. A week or more later the eggs hatch into young aphis-lions, which, like their namesakes of the desert, go about seeking what they may devour.

While the beauty of the color and structure of the Lace-wing appeals strongly to the eye of the nature-lover, the insect has a very different effect upon his nose; for these delicate creatures emit probably the most disagreeable odor of any insects. It is worse, to many minds at least, than that given off by the bedbug and its allies, or even the noisome pestilence of the carrion-beetles. How so small an insect, reared from infancy upon a cleanly diet of the juices of just-killed animals, spending its resting period in a "glistening, white cocoon, which looks like a large seed-pearl," and deriving nourishment as an adult from cleanly sources, can develop so disagreeable a stench is indeed a wonder. But this is only one of many similar marvels that have been produced in the age-long struggle for existence through which the countless generations of insect life have passed. The purpose of the odor is doubtless to protect the Lace-wing from the attacks of birds and other enemies.

The Lace-wings belong to the family Chrysopidæ of the order Neuroptera. Most of the species are placed in the single genus Chrysopa. The stages of *C. oculata* are illustrated in the accompanying figure, for the loan of which we are indebted to the Cornell University Experiment Station.

BIOLOGICAL STUDIES IN MASSACHUSETTS, No. 1.

BY G. C. WHIPPLE.

Within recent years the subject of sanitary biology has become one of great importance. The marvelous discoveries and practical applications of bacteriology have been of benefit to surgeon and sanitarian, and the people of the world to-day are better able to fight disease than ever before. Scientists all over the world are assisting in the work of establishing proper relations between man and his microscopic neighbors. Admitting, as we must, that the most important and far-reaching discoveries have eminated from the continent of Europe, we ought not to overlook the work that is being done on this side of the Atlantic, which is by no means insignificant or second-rate. To prove this it is not necessary to mention the names of men who have already acquired a reputation beyond our own borders, their work is evident in our improving water supplies, our better methods in all departments of sanitation, and the increasing popular appreciation of cleanliness.

There is one branch of sanitary biology that has been carried on more extensively in Massachusetts than anywhere else,—namely, the microscopical examination[1] of drinking water; and it is, therefore, perhaps not undeserving of the brief description here to be given.

It is unnecessary to relate the early history of the subject in this state, for, although the work of Nichols, Farlow, and others, was most interesting and valuable, it was not until the State Board of Health began its investigations in 1887 that much attention was given to the quantitative determination of the microscopical organisms. The method of examination first used was the "cloth method" of G. H. Parker. Two hundred cubic centimeters of the water was poured through a funnel over the neck of which a piece of fine cloth was firmly tied, and the organisms caught by the cloth were subsequently transferred to a small quantity of water, and placed under the microscope for identification and enumeration. In June, 1889, the "cloth method" was superseded by the "sand method" devised by A. L. Kean, and improved by Prof. Sedgwick. The water was filtered through sand instead of cloth, after which the sand with its collected organisms was washed into a deep cell and placed on the stage of the microscope. To assist in the enumeration the bottom of the cell was ruled in squares. This method was used until November, 1890, when the Sedgwick-Rafter method, hereafter described, was adopted. This method, with but slight modifications, has been used to the present time. In the course of the whole series of investigations by the State Board of Health it is estimated that upwards of 16,000 samples of water have been submitted to microscopical examination—2,000 by the cloth method, 2,000 by the sand method, and 12,000 by the Sedgwick-Rafter method. The samples cover all parts of the state, and include almost all possible sources of water supply—lakes, ponds, artificial reservoirs, brooks, rivers, springs, wells, filter galleries, etc.

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[1] The microscopical examination deals only with the comparatively large forms of micro-organisms, such as the algæ, infusoria, etc., and is not concerned with the bacteria, the study of which forms an entirely distinct branch of sanitary biology.

Next in importance to the work of the State Board of Health, and in some respects surpassing it, is the biological work of the Boston Water Supply Department. These investigations have involved the examination of more than 20,000 samples of water, collected chiefly from the various portions of the city supply. The Sedgwick-Rafter method has been used from the start, though from time to time several improvements have been introduced.

In the summer of 1893 the Public Water Board of the City of Lynn fitted up a biological laboratory in the basement of the city hall for the weekly microscopical and bacteriological examination of the water supply. The bacteriological work was not continued long, but the microscopical examinations are still being made. The total number of examinations by the Sedgwick-Rafter method now exceeds 2,000.

The grand total of the number of microscopical examinations made in these three laboratories added to a large number made by F. F. Forbes in his studies of the Brookline water, and by others interested in the subject, is not far from 40,000.

As the biological laboratory of the Boston Water Works is typical of the methods and nature of the work under discussion, a description of it will occupy the remaining portion of this paper. It was established in the fall of 1889 by Mr. Desmond Fitz Gerald, C. E., Supt. of the Western Division of the Water Works, and since then the work has been carried on under his general direction. Prof. James I. Peck had charge of the laboratory during the first few months of its existence; but since January 1, 1890, it has been in charge of the writer. The working force consists of one biologist, two (sometimes three) assistant biologists, and a number of attendants at the various reservoirs who devote a portion of their time to the collecting of samples, the observation of temperature, etc. The laboratory building is situated upon the shore of the beautiful Chestnut Hill Reservoir. (Plate XIII.) It is near the high service pumping station,from which it receives steam heat and electric light. A gas machine supplies it with gas.

The object of the laboratory work is to ascertain and keep record of the condition of the water in all parts of the supply at all times. Reports are made weekly to the Superintendent and Water Commissioner. These enable the supply to be managed in the best possible manner so far as the quality of the water is concerned, and they have more than once prevented water of inferior quality from being sent into the city.

The work of the laboratory may be considered under the following heads: 1. Environmental and Physical; 2. Microscopical; 3. Bacteriological; 4. Photomicrographical; 5. Experimental.

1. *Environmental and Physical.*—Samples of water for examination are collected weekly from all parts of the supply, namely, from Lake Cochituate, the Sudbury Storage Reservoirs and their inflowing streams, the aqueducts, distributing reservoirs and service pipes, and sent by express to the laboratory. Glass-stoppered, one-litre bottles are used, thoroughly packed in felt-lined boxes. In all the reservoirs samples are collected at the surface, mid-depth, and bottom. The following apparatus (Plate XIV.) has been found the most convenient for securing samples from beneath the surface. The frame for holding

the bottle consists of a brass wire (A) attached to a weight (B) from which strips of brass extend upwards terminating in clips (C). These brass strips have considerable spring, and serve to hold the bottle in place. The frame is supported by the spring (F) attached to the sinking rope (E). A flexible cord (G) extends from the top of the spring (E) to the stopper (H) of the bottle. The length of this cord and the length and stiffness of the spring are so adjusted that when the apparatus is suspended in the water the flexible cord will be a little slack. In this condition it is lowered to the required depth. A sudded jerk given to the sinking rope stretches the spring, produces tension on the flexible cord, and pulls out the stopper. A slack safety cord (not shown in the figure) extends from E to J to prevent too great a stretching of the spring and to guard against loss of apparatus in case the spring should break. For great depths, where the pressure is too great to allow of the stopper being removed, a smaller aperture is used.

The temperature of each sample is recorded at the time of collection, and additional series of observations upon the temperature of the water at various depth are carried on, using for this purpose the newly invented Thermophone. These observations give useful information regarding the circulation of the water. When the samples reach the laboratory, record is made of the color (using the platinum-cobalt standard in a colorimeter of special design), transparency, amount of sediment, taste, and odor.

Environmental studies are carried on by personal inspection of the watershed, and the collection of numerous extra samples from the small brooks and feeders. These inspection trips are made whenever anything abnormal appears in the condition of the water.

2. *Microscopical.*—The microscopical work is the most important part of the laboratory routine. It consists chiefly in the quantitative determination of the various micro-organisms (except the bacteria) in each sample of water by the Sedgwick-Rafter method. At the present time this is carried on as follows: 500 c.c. of the water to be examined is filtered through a thin layer of quartz sand supported at the bottom of a cylin-

drical glass funnel upon a perforated rubber stopper, covered with a disc of bolting cloth, the filtration sometimes being hastened by the use of the aspirator. The sand with whatever organisms have collected upon it is then washed into a test tube with 5 or 10 c.c. of distilled water, thus concentrating the organisms. This tube is shaken, and the water decanted to a second tube, the sand being left behind. 1 c.c. of this fluid containing the concentrated organisms is next placed in a cell, 50 x 20 mm. and 1 mm. deep, covered with a thick cover glass and placed under the microscope. A ruled square in the micrometer ocular covers one square millimeter on the stage, *i. e.*, one-thousandth of the area of the cell. The organisms seen within this square are then counted, and the cell is moved so that other portions come into view. Having counted a definite number of these squares the determination of the number of organisms in the original sample is a matter of calculation. On account of the great variety in size which the different organisms present it has been found expedient to adopt a standard unit of size (400 square microns) in terms of which all organisms are recorded. The organisms are classified according to the following convenient grouping: 1. Diatomacæ; 2. Chlorophyceæ; 3. Cyanophyceæ; 4. Fungi; 5. Rhizopoda; 6. Infusoria; 7. Rotifera; 8. Crustacea; 9. Miscellaneous.

Occasionally microscopical examinations are made in the field, in order to study the sample while fresh and before the organisms have begun to break up. For this purpose a convenient portable outfit is provided. Another feature of the microscopical work consists of the examination of material from the shores and bottoms of the reservoirs, the organisms growing in the swamps, along the streams, and upon the walls of the aqueducts and distribution pipes.

3. *Bacteriological.*—The bacteriological work is chiefly the weekly determination of the number of bacteria in the water of the aqueducts, distribution reservoirs and service pipes by means of the ordinary methods of culture. More or less study is given to the various species observed, and a careful watch is kept for the presence of *Coli communis*, whose presence to a certain extent is considered an index of pollution. At some-

what longer intervals samples for bacteriological examination are collected from the brooks in the more thickly settled portions of the watershed and from the various filter beds. Samples from beneath the surface of the reservoirs are collected in sterilized vacuum tubes, lowered to position in heavy lead tubes; the seal is broken by an arrangement of spring and flexible cord in a manner similar to that described above. On account of the uncertainty which surrounds the methods of bacteriology at the present day comparatively little of the bacteriological work has been published.

4. *Photomicrographical.*—For some time after the establishment of the laboratory much attention was given to the subject of photography, and excellent photomicrographs of most of the important organisms have been secured. Of late the time required for this work has been given over to the more important bacteriological investigations.

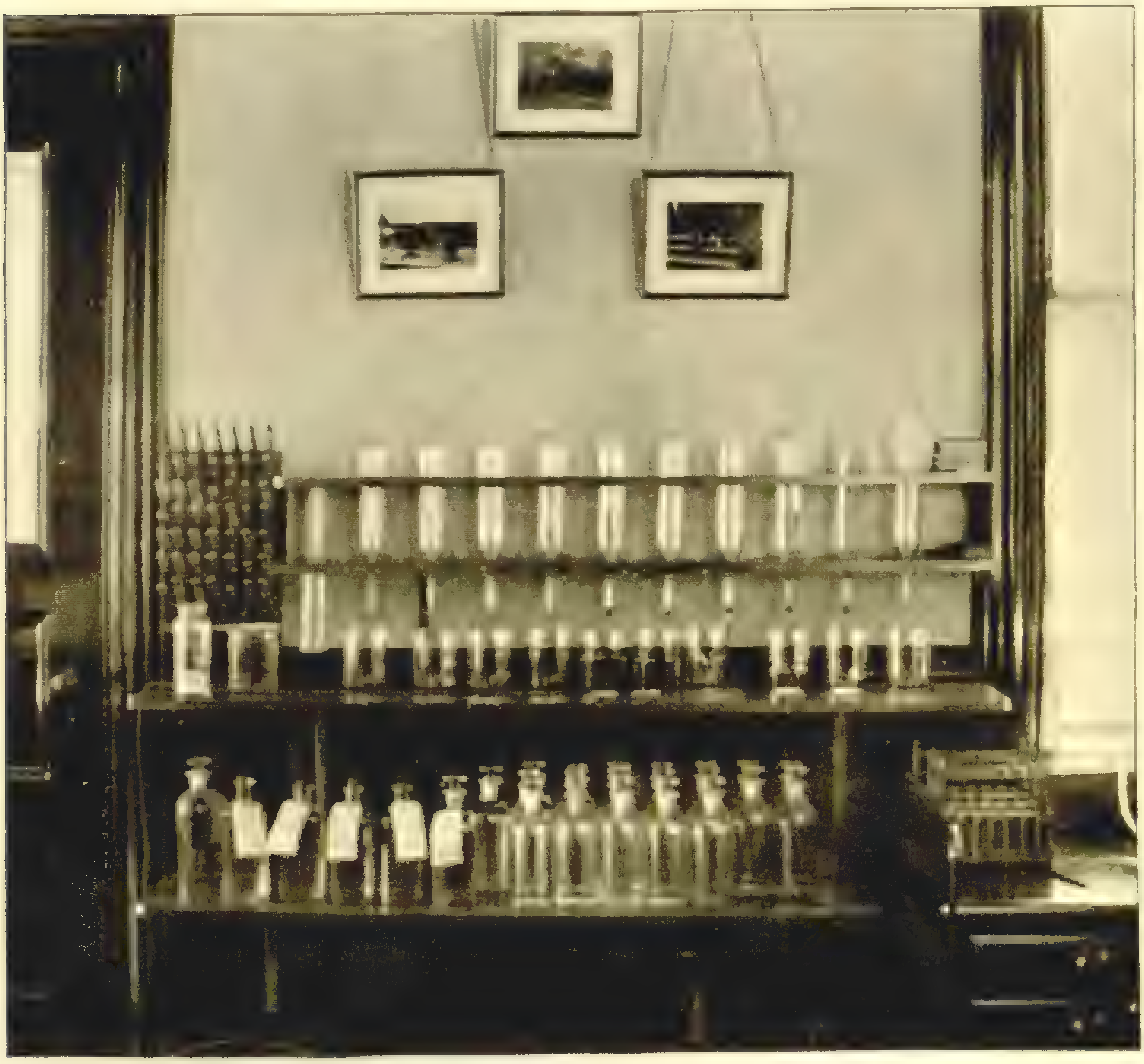
5. *Experimental.*—In addition to the routine work many experiments of a practical and scientific nature have been carried on. Of the subjects investigated the following may be given as illustrations: The cause of the seasonal distribution of the various classes of organisms. The effect of temperature, light and air upon the growth of diatoms. The cause and extent of the taste produced in water by organisms. The effect of swamps upon the quality of a water supply. A study of "stagnation phenomena" in a deep pond. The bleaching action of sunlight. The efficiency of sand and mechanical filtration in the purification of water.

Comparatively little *chemical* work is done in the laboratory, as this branch of the subject is deemed sufficiently treated in the monthly examinations of the State Board of Health.

Taken together, all the biological work of the character described that has been done in Massachusetts during the past ten years is of great value from a purely scientific as well as from a sanitary standpoint; and the increasing importance of the subject and the growing interest in limnological studies in other countries make it desirable that this work should be better known. It is the intention to bring together in this series of articles an outline of the work done, and some of the most important of the results obtained, treating the subject not so much from a sanitary as from a biological point of view.

PLATE XIII.

Biological Laboratory. Boston Water Works.



Battery of Filters. Sedgwick-Rafter Method.

PLATE XIV.

APPARATUS FOR COLLECTING SAMPLES OF WATER.

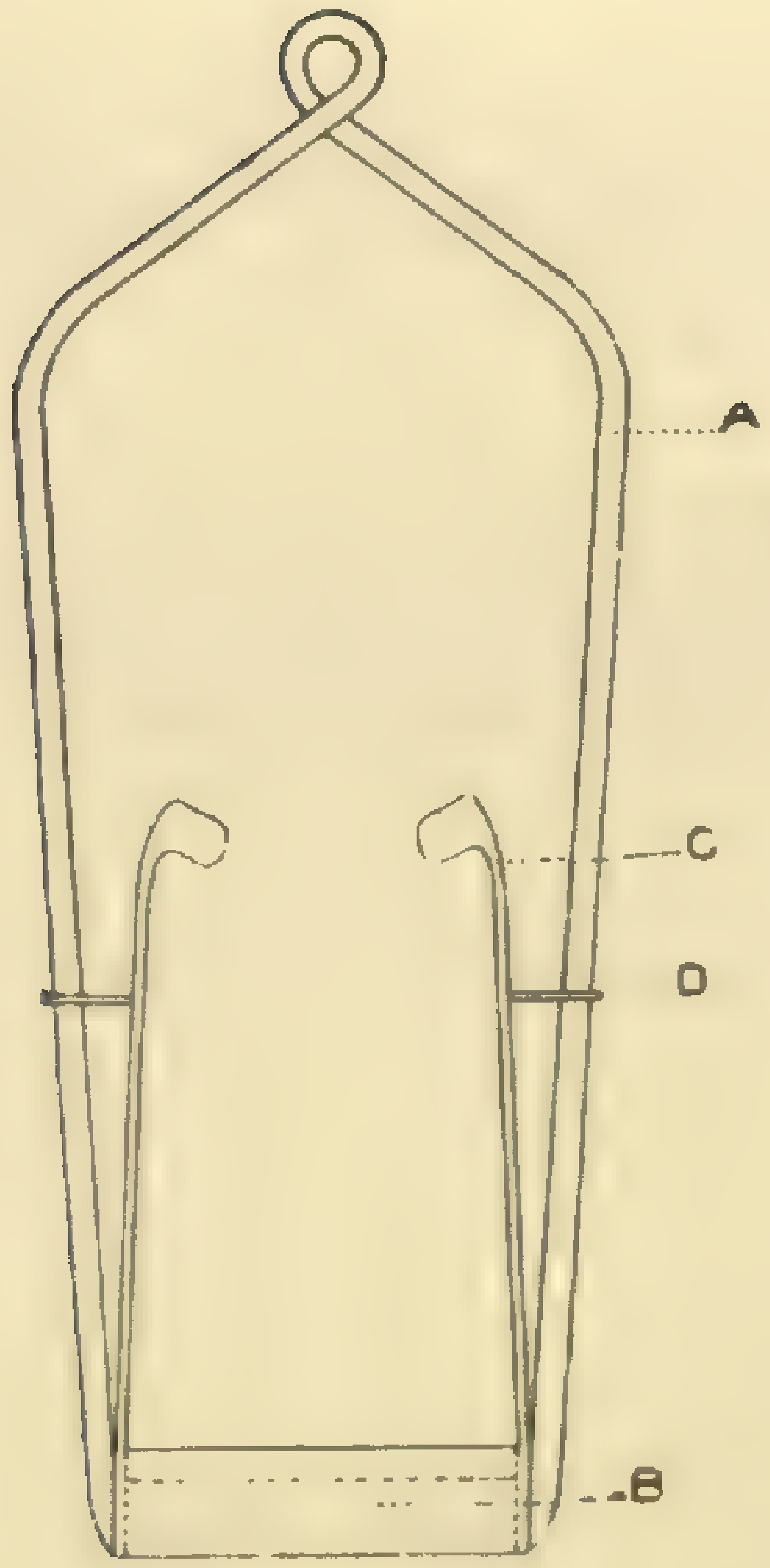


FIG. 1.

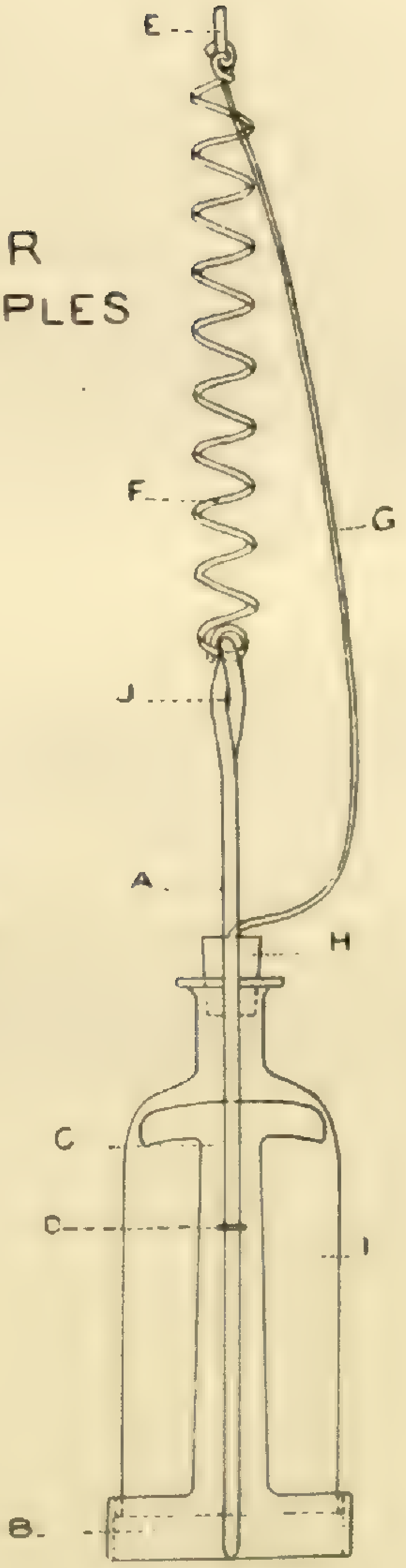

E
F
G
J
A
H
C
D
I
B

FIG. 2

EDITOR'S TABLE.[1]

That the human mind works similarly under similar circumstances, is well known. That the tendencies of thought are similar at similar periods of life and experience, is also well known. The scientific mind presents such phenomena no less than the minds of other men, but modified by the conditions necessary to its peculiar occupation. What naturalist does not know that the young investigator has a tendency to exaggerate the defects and errors of his predecessors, and that he takes great delight in exposing the same? This tendency generally disappears as success in research rewards his own exertions. Who does not know with what lofty scorn the anatomist and histologist regards the discoverer of previously unknown species, and him who arranges the same according to their characters in systematic order. And yet, after he has made a good record of errors in capital questions for want of systematic knowledge, he is at last glad to have the taxonomist identify his specimens for him. That any one should think the describing of cells or nuclei more scientific than the describing of feathers or scales, is only due to the respect for thaumaturgy which still lingers in the scientific mind, while it runs riot in the populace. It will not be long before it will be as scientific to see a thing with the naked eye, as to see it through a brass tube furnished with lenses. If to such merit be added the further one of publishing beautifully colored pictures, a higher flight for scientific thought has been attained. While an important adjunct of biologic research, section cutting is not the only guide to a knowledge of biology, as may be readily derived by a reading of the remarkable hypotheses put forth from time to time in matters of phylogeny, by the cultivators of this fine art. It is time that managers of educational institutions in America knew that to learn how to cut and stain sections in Germany does not necessarily make a man either a knower or teacher of biology. And this brings us to the question of scientific fads or fashions. We have no fault to find with them, but cite them in further proof of the truism that human minds are at basis very much alike. An able investigator of popular personality, can easily create a fad, especially among his patriotic countrymen.

[1] This short essay marked by our late lamented Chief Editor "Editorial" is one of the last from his pen which will appear in that column. It is appropriately general in theme and untechnical in treatment: nevertheless it contains wise counsel to the budding naturalist, and is from a master who has had great experience. We heartily commend it to young students.—P. F.

National characteristics are often reflected in the scientific men of different nations. This is seen in the varied manner of reception of the new candidate for scientific recognition in different countries. If he have money and proper social endorsement, our English speaking cousins receive him without question. If he have neither of these things, he is received with tail in air, the hairs of the median dorsal line elevated, a tremulous movement of the upper lip of one side; especially if he have discovered many new species. In France he is received with open arms. In Germany he is received on his merits.

RECENT LITERATURE.

Life in Ponds and Streams.[1]—Considerable labor was evidently spent in compiling this collector's hand-book, which, in spite of several very bad blunders, will doubtless be of much use to the British amateur collector. Americans would prefer a hand-book dealing with the fauna of their own ponds and streams. However, the general plan of the work is a good one; the animal kingdom is briefly passed in review, directions are given for the construction of apparatus, for the construction and care of aquaria, and then the different animal groups treated somewhat in detail. Keys are given that will enable the British collector to readily identify his discoveries.

It is unfortunate that in several instances the work is marred by some very glaring blunders. A figure of a species of *Scolopendra* is given with the legend, "The centipede (*Lithobius*)". Another equally bad error occurs in the case of a figure of one of the most ordinary three lens pocket magnifiers, which is called "The Coddington lens." Further, those familiar with the group of insects and related forms will be astonished to find that the author begins with the Hemiptera and follows them with the Thysanura after saying that he will begin his enumeration of the orders with the lowest. Exception also may be taken to the use of the adjective "gellatinous" in speaking of the amœba.

Such an exhibition of carelessness or indifference considerably deters one from giving the recommendation that one might otherwise be inclined to give.—F. C. K.

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[1] W. Furneaux, 12 mo., 399 pp., 311 figs., 8 pls. (colored). Langmans, Green & Co., 1896; price $3 50.

Year Book of the U. S. Agricultural Department for 1895.[2]—It has been the aim of the Department of Agriculture to make this report for 1895 a concise reference book of useful information for all who are interested in agricultural pursuits. It consists of (1) a general report of the operations of the Department, (2) a series of popular well-illustrated essays discussing the results of investigations in agricultural science, or new developments in farm practice, (3) an appendix containing information compiled from miscellaneous government publications. The volume is especially adapted to the farmers of the country.

Mach's Popular Lectures.[3]—A series of twelve popular scientific lectures delivered by Herr Mach during the years 1864–94, are here published in collected form for the first time. The volume at hand is an English translation by T. J. McCormick, whose version is endorsed by Herr Mach. The subjects are chosen from the field of Physics. In all, twelve lectures are given, four of which are of a philosophical character, and deal with the methods and nature of scientific inquiry.

Martin's Human Body.[4]—We have here the seventh edition of the well-known text-book, originally issued in 1880. The present edition has been brought up to date by revision and correction of the old text, and by the addition of new matter, especially in connection with the cardiac and vascular nerves, and the physiology of the brain. In its present form it stands close to the ideal text-book. The facts are stated simply and concisely, repetition avoided, and, in general, its aim seems to be to present what is known as such, but at the same time to suggest opportunities for further discoveries in physiological science.

The illustrations are numerous and well-chosen. About thirty, chiefly diagrammatic, were drawn especially for the work.

Geology of Pennsylvania.[5]—This work constitutes Vol. III, Pt. 1 of the Summary Description of the Geology of the State. It contains Prof. Lesley's chapters on the subconglomerate measures, Mr.

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[2] Year Book of the U. S. Department of Agriculture for 1895. Washington, 1896.

[3] Popular Scientific Lectures. By Earnst Mash. Translated by T. J. McCormick. Chicago: Open Court Pub. Co., 1896.

[4] The Human Body. By H. Newell Martin, Seventh edition, revised. New York, 1896: Henry Holt & Co., Pub.

[5] Summary Final Report Pennsylvania Geological Survey, Vol. III, Pt. I, 1895. Carboniferous.

d'Invilliers' report on the Mauch Chunk red shale and Pottsville conglomerate series, outside of the anthracite region, and the results of Mr. A. Dw. Smith's studies of the anthracite coal measures.

From the report upon the Mauch Chunk shales we find that geologists still have before them the problem of the abrupt transition from the finest red mud to the coarsest pudding stone or gravel rock which is observed throughout the eastern part of the State, a transition which does not conform to any theory yet devised.

Mr. Smith's paper is a detailed account of the comparative quantity and quality of the coal basins in the different "fields" of the anthracite region.

The illustrations include 190 page plates showing maps, sections and diagrams, and figures of the representative fossil forms found in the beds under discussion.

U. S. Commission of Fish and Fisheries, Pt. XX.[6]—This volume contains the reports of the Commissioner and his assistants for the year ending June 30, 1894. The subjects to which attention is directed are the propagation and distribution of food-fishes and the explorations of fishing-grounds. More than half of the volume is devoted to appendices comprising papers by specialists based on the work of the Commission.

The summary of distribution shows that during the year 33 species of fish and 1 crustacean, the lobster, were sent to various parts of the United States and to the following foreign countries: Canada, Mexico, United States of Columbia, Belgium, France, Scotland, Switzerland, and Japan.

Animals at Work and Play.[7]—This little volume, of some 320 pages, comprises a series of papers dealing with the general activities and emotions of animals in their every day life. The author points out their little fads in bed-making and in house-keeping generally; their social instincts, fondness for play and consequent sense of humor; their delight in personal cleanliness and the different methods of making their "toilettes;" how they resort to herbs for ailments, and a variety of other interesting customs among what we are pleased to term "the lower creatures." In fact, he so "humanizes" his birds and beasts that the reader finds them most companionable. One chapter of especial interest is " Homes for Wild Birds," offering suggestions for enticing migrating birds to establish themselves in places where they are needed either as insect-catchers or where they are wanted to fulfil their mission of song and beauty.

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[6] Report of the U. S. Commissioner Fish and Fisheries for the year ending June 30, 1894. Washington, 1896.

[7] Animals at Work and Play. By C. J. Cornish. Macmillan & Co,, New York, 1896, 8vo., $1.75.

Annual Report for 1894, Geological Survey of Canada.[8]—This volume includes, besides the summary report of the Director of the Survey, a series of seven systematic, detailed reports on special work in particular regions of the Dominion. These several reports have been previously issued, as completed, and may be obtained separately.

The Director's report includes extended notices of the preliminary results of the various scientific investigations and explorations in the field, notably those of Mr. A. P. Low in Labrador and Mr. J. B. Tyrrel in a second expedition to the country west of Hudson Bay and north of the Churchill River. Attention also is called to the importance of the investigations of the petroleum fields of Athabasca and northern Alberta, as all indications favor the existence of a great oil-bearing region in the northwest.

The volume comprises 1206 pages. It is accompanied by eleven maps and illustrated by fifteen plates and diagrams, besides a number of figures in the text.

Thaxter's Laboulbeniaceæ.[9]—In a stately quarto volume of two hundred and forty-two beautifully printed pages and twenty-six plates crowded with six hundred and seventy-two elegantly drawn figures, Dr. Thaxter makes a notable addition to botanical science. Beginning his studies in 1890 when the known species in the world were but fifteen, of which but one was known to be North American, the author has brought to light so many new species that to-day there are no less than one hundred and fifty-eight known, and he estimates that when all the species throughout the world are discovered, the total number may be from five hundred to one thousand. Thus there is injected into our system of the fungi a group of no mean importance in point of numbers, which hitherto has been so little known as to be pretty generally ignored. Hereafter, even a general survey of the fungi must include some notice of this group.

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[8] Annual Report for 1894 (new series), Vol. VII, Geological Survey of Canada. Ottawa, 1896.

[9] Contribution Towards a Monograph of the Laboulbeniaceæ. By Roland Thaxter. Memoirs of the American Academy of Arts and Sciences, XII. Presented May 8, 1895, published December, 1896.

The Laboulbeniaceæ are minute, stalked and commonly bristle-bearing parasites occurring upon beetles and, to a less extent, other insects. They are so small that only the keenest eyes can detect them without the aid of a good pocket-lens. They are most common upon insects living in moist places, although by no means uncommon upon those living in other situations. A close examination of any entomological collection of beetles is almost certain to be rewarded by the discovery of many specimens. Dr. Thaxter recommends examining the beetles suspected of harboring these parasites first over a dull white and then over a black surface, using a hand-lens magnifying from eight to ten diameters. " Every portion of the insect should be examined in different positions, and when the parasites have been discovered, they should be removed by means of a dissecting-needle inserted in a match far enough to give it the requisite stiffness, while its apex should have been ground on a fine oil-stone until a sharp, slightly oblique chisel-point has been obtained. With such a point, the individuals are scraped off without much difficulty, and should be transferred to a very small drop of water on the slide."

Structurally, these tiny fungi have the following characteristics: "A main body, or receptacle, is fixed by means of a blackened base, or foot, to the integument of the host, and consists, in most cases, of a very small number of cells differently arranged in different genera. This receptacle gives rise above to certain peculiar appendages of very variable form, commonly connected with the production of the male sexual organs; while from the same individual, with few exceptions, in which the plants are diœcious, female organs are also variously produced, from which perithecia are eventually developed. In the perithecia, which may arise, singly or in considerable numbers from a given individual, and which are quite remarkable in structure, are produced the reproductive bodies or ascospores that are formed in asci identical in all respects with the organs thus named in other members of the great group of ascomycetous fungi."

A close study of the structure of these minute plants shows clearly their relationship to the Rhodophyceæ, and since they are also, without doubt, true Ascomyceteæ, we have here a strong suggestion as to the origin of the asco-fungi. The author's guarded remarks that such a supposition " is not unworthy of consideration," and that such a theory " is more probable as well as more logical than that which is usually held," are quite justified by the structure which he so clearly describes and figures. This work is therefore a welcome confirmation of the views of those who, like the present reviewer, have held on theoretical grounds that the Ascomyceteæ are modified and degraded Rhodophyceæ.

The genera are disposed as follows by Dr. Thaxter :—

Family LABOULBENIACEÆ.

Group I, ENDOGENÆ, with antherozoid produced endogenously.

Order Peyritschielleæ.

Genera *Dimorphomyces, Dimeromyces, Cantharomyces, Haplomyces, Eucantharomyces, Camptomyces, Enarthromyces, Peyritschiella, Dichomyces, Hydræomyces, Chitonomyces.*

Order Laboulbenieæ.

Genera *Amorphomyces, Helminthophana, Stigmatomyces, Idiomyces, Corethromyces, Rhadinomyces, Rhizomyces, Laboulbenia, Tetratomyces, Diplomyces, Rhachomyces, Chastomyces, Sphaleromyces, Compsomyces, Moschomyces.*

Group II, EXOGENÆ, with antherozoids produced exogenously.

Order Zodiomyceteæ.

Genera *Ceratomyces, Zodiomyces.* —CHARLES E. BESSEY.

Recent Text-Books.—Some years ago we noticed the first part of an Introduction to Entomology by Professor Comstock, and we thought when we received the present volume[1] that we at last had the completed work ; but a moment's examination showed that we had instead an entirely new work, somewhat smaller than the other would have been. It is essentially a work for the beginner in entomology, and contains just those things about species which the beginner wants to know. It begins with an essay on classification, etc., and then passes to a consideration of the Arthropoda, in which the Crustacea and Myriopoda are dismissed with short shrift and the Arachnida are treated with a little more detail, and then begins the discussion of the insects proper (*i. e.*, Hexapods). The general account of these is rather short, but is clear and accurate as a whole. These subjects already mentioned occupy 77 pages, the rest is devoted to classification. Professor Comstock divides the insects into the Orders :—Thysanura, Ephemerida, Odonata, Plecoptera, Isoptera, Corrodentia, Mallophaga, Dermaptera, Orthoptera, Physopoda, Hemiptera, Neuroptera, Mecaptera, Trichoptera, Lipidoptera, Diptera, Siphonoptera‘ Coleoptera, Hymenoptera—and these are treated in the order given. The author, however, disarms critisism of this arrangement by his words on p. 77. Among the specially noticeable features may be mentioned the uniformity which pervades the whole work, and this extends to a uniform notation of the veins of the wings, a thing which has long been lacking. We cannot dismiss our notice of this work without mention of the beautiful illustrations from the graver of Mrs. Comstock. For years the illustrations of Flint's edition of Harris have been the standard for wood-cuts of insects, but in not a few instances has Mrs. Comstock surpassed Mr. Marsh. We have no doubt about the sale of the present work ; every entomologist will want it, and we know of no better book to put in the hands of those youth who persist in bringing all sorts of bugs into the house. Yet we regret certain features in the work, for which, doubtless, there was good reason. Thus the lack of reference to the literature of the different groups, a feature found in the part of the "Introduction" already published is a serious omission. Then, too, we could have wished more morphology and a little outline of the development of insects, while we could have wished for portions on geographical distribution, mimicry and other means of protection, etc. But we forget all these lacks when we look at Fig. 190, which ought to have appeared in the "Fliegende Blätter."

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[1] A Manual for the Study of Insects. By John Henry Comstock and Anna Botsford Comstock. Ithaca, N. Y. : Comstock Pub. Co., 1895, 80 pp. x+701.

The Cell.[2]—The want of a good comprehensive account of the Anatomy and Physiology of the Cell has induced Dr. H. J. Campbell to edit an English translation of Dr. O. Hertwig's valuable treatise on this subject. In the author's preface Dr. Hertwig states that in this work he has endeavored to fix the standpoint occupied at present by the doctrines of cell and tissue formation, and to delineate the historical course of the development of the more important theories. The points discussed in the several chapters are: the chemico-physical and morphological properties of the cell, the vital properties, vital phenomena, metabolic changes occurring between protoplasm, nucleus and cell products, and theories of heredity. Each of these topics is exhaustively considered, and a very full bibliography is given of the subject under discussion.

The work abounds in cuts illustrating the text.

Elementary Text-Book of Entomology.[3]—This book, of which the recent edition has just been issued, is intended as an introduction to the study of insects in general. For convenience the author adopts the following system of classification, viz.: *Coleoptera* (including *Strepsiptera*), *Orthoptera* (including *Euplexoptera* and *Dictyoptera*), *Neuroptera* (including *Trichoptera, Thysanura, Collembola, Mallophaga* and *Thysanoptera*), *Hymenoptera, Lepidoptera, Hemiptera* (including the sub-orders *Hemiptera-Heteroptera* and *Hemiptera-Homoptera*, and the *Anoplura*), and *Diptera* (including *Aphaniptera*, and possibly *Achreioptera*).

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[2] The Cell : Outlines of General Anatomy and Physiology. By Dr. Oscar Hertwig. Translated by M. Campbell and edited by H. J. Campbell, M. D. New York, 1895, Macmillan & Co., $3.00.

[3] Elementary Text-Book of Entomology. By W. F. Kirby, F. L. S., F. E. S. Second edition, revised and augmented, with 87 plates, containing over 650 figures. London : Swan, Sonnenschein & Co. New York : Macmillan & Co., 1892.

After an introduction concerning insects in general, Mr. Kirby takes up each Order in turn, giving an account of its principal Families, with observations on their habits and economic importance. Many typical species are described and figured, so that it is comparatively easy for the student to identify the principal divisions.

A complete index adds to the usefulness of the book.

The work is necessarily of a very general character, and is well-adapted to serve as an introduction to a fascinating science.

Birds of Illinois.[4]—The Natural History Survey of Illinois has published its second volume, part I, a continuation of the descriptive catalogue of the birds of that State, by Robert Ridgway. The Orders treated of in the present volume are the Gallinæ, Limicolæ, Alectorides, Herodiones, Anseres, Steganopodes, Longipennes and Pygopodes.

Thirty-three full page plates give the heads, feet and legs of characteristic types of the Orders.

Mr. Ridgway's well-known competency in this field insures the value of the work.

The Forces of Nature.[5]—A small octavo, of some 150 pages, in which are briefly stated the fundamental principles of the laws which govern the operations of nature. Part I contains five chapters treating respectively of the solar system, sound, structure of matter, radiant energy and electricity. Part II comprises a series of disconnected paragraphs, giving the latest discoveries in the physical sciences. This volume is at all odds the most elementary treatise on the subject that could have been devised.

[4] The Ornithology of Illinois. By Robert Ridgway. Natural History Survey of Illinois, Vol. II, Pt. I, Springfield, 1895.

[5] The Forces of Nature. By H. B. Harrop and L. A. Wallis. Columbus, Ohio, 1895.

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General Notes.

PETROGRAPHY.[1]

Mud Enclosures in Triassic Trap of New England.—Emerson,[2] in an interesting and well illustrated paper, gives an account of tuff deposits at Granby and Holyoke, Mass., and of a sandstone containing fragments of a diabase very rich in feldspar existing a few feet above the Holyoke trap sheet in the valley between Tom and Little Mountains. At Dibbles and at other places the normal 'trap' of the region is filled with enclosures of a calcareous mud, which are so related to the enclosing rock as to leave no doubt that the mud was forced into the trap before solidification took place. In its advance the rolling lava sheet carried some of the mud beneath it, so that it now contains a muddy lower layer as well as a muddy upper layer. In places, especially near Greenfield, Mass., the trap, which is mainly a diabase, solidified as pitchstone, as a result probably of the action of the steam generated by the heating of the lower mud stratum. In these places the lower portion of the sheet is a mixture of sand, fragments of sandstone, fragments of diabase and of pitchstone, all cemented together by glass, which is cracked and shattered. In the crevices thus formed albite, diopside and other minerals have been deposited. Elsewhere, sandstones and diabase glass, trap and breccia are intermixed in great confusion. The petrographical description of all the types of breccia and pitchstones are faithfully given by the author. The glasses in the glass breccia of Meriden, analyzed by Stokes, is composed as follows:

SiO_2	TiO_2	CO_2	P_2O_5	F	Al_2O_3	Fe_2O_3	FeO	MnO	BaO	CaO	MgO	K_2O	Na_2O	H_2O	Total
46.86	1.13	2.19	.15	tr	13.96	5.23	4.67	tr	.03	9.42	7.69	2.02	1.85	4.72	— 99.92

The lava sheet is supposed to have moved over the bottom of a water basin blending with the mud and sand with which this bottom was covered. The mud was drawn up into the liquid lava by currents, and the great amount of water thus introduced caused it to solidify locally as a spherulitic glass with the composition indicated above. Explosions of steam took place before the glass had completely cooled, forming a breccia of mud, sand, solidified lava, partially solid glass. At one place this mixture broke through the trap sheet forming a mud volcano. A large number of handsome plates illustrate the descriptions.

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Bull. Geol. Soc. Amer., Vol. 8, p. 59.

A Keratophyre Dyke near New Haven.—Hovey[3] declares that a keratophyre dyke cuts the Triassic sandstones near New Haven, Conn. It is one of seven dykes, the remaining six being diabases. The keratophyre contains two sets of feldspar phenocrysts. One set consists of large crystals of albite and the other of acicular crystals of anorthoclase. The matrix in which these lie looks like a devitrified glass. Analysis gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	Mno	MgO	CaO	Na_2O	K_2O	Ign	Total
60.13	tr	20.47	1.04	.72	tr	1.15	2.59	9.60	1.06	3.44=	100.20

The loss on ignition is largely CO_2. This is the first acid dyke reported in the Triassic sandstone of the Atlantic border.

The Gabbros near Ronsperg, Bohemia.—A group of rocks belonging to the gabbro family is described by Martin[4] from the vicinity of Ronsperg, Bohemia. Gabbros and olivine-gabbros are the principal rock types met with. They constitute intrusive layers between pegmatite and amphibolite. Near the amphibolite the gabbros grade into quartz diorites. At Hoslau a smaragdite gabbro occurs in scattered ledges, and between these, near a granite with which the basic rock may be in contact, are ledges of norite. Wehrlite ledges are also found in the same vicinity. These are believed by the author to be basic inclusions in the intrusive rock. The olivine of the olivine-gabbro is often surrounded by a rim consisting of orthorhombic pyroxene, brown, green and colorless hornblende, and spinel, all of which are thought to be secondary. Diallage and orthorhombic pyroxenes, and this mineral and olivine, are often in parallel growths when all are original. The smaragdite-gabbro is much decomposed, its diallage having been changed to smaragdite and its plagioclase to cloudy grains filled with zoisite and clinochlor.

Exotic Blocks in the Eocene Schists of the Alps.—The Eocene schists of the Alps have long been known to include exotic blocks or boulders, that are different in character from the blocks and boulders found in the glacial drift of the district. König[5] has recently described those occurring in the schists near Stockerau as micro-granites, granophyres, granites, gneisses and mica schists, but has not succeeded in tracing them to their origin.

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[3] Amer. Jour. Sci., III, 1897, p. 287.

[4] Min u. Petrog. Mitth., XVI, 1896, p. 105.

The Eleolite-Syenite of the Serra Monchique.—Kraatz,[6] Koschlau and Hackman give a very thorough account of the well known eleolite-syenites of the Serra Monchique, Portugal. Two principal types of the rock are distinguished. One is the coarse grained type from Picota and the other a finer grained type from Foia. These are crossed by streaks (Schlieren) of fine grained rock, and in them are basic concretions. The eleolite-syenite has produced marked contact effects in the surrounding sedimentaries and has suffered corresponding changes on the periphery of its mass. A system of dykes cutting the syenite comprises bostonite-porphyry, leucite-tinguaite, vitrophyre, ægirine-tinguaites, eleolite-syenite porphry, camptonitic-tinguaites, nepheline-tephrite, monochiquite and camptonite.

The Picota rock may be a deeper facies than the Foia rock. It consists essentially of eleolite and feldspar, with a few dark colored components forming a granitic or a trachytic aggregate. The dark colored components are diopside, often with an ægirine or an ægirine-augite border, sphene, biotite and lavenite. Except the first named they are all in small quantity. Analyses show the presence of 37.44% soda-orthoclase, 24.34% albite, 14.43% nepheline, 11.6% augite, 10.21% lepidomelane and .22% sphene. The Foia rock differs from the Picota type in the presence of but a small quantity of nepheline and in its finer grain. In some of its varieties it resembles strongly the pulaskite of Arkansas both in appearance and in composition. An analysis of the Portugese rock yielded :

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	MgO	CaO	K_2O	Na_2O	H_2O	Total
60.42	—	19.23	.63	3.19		.67	1.73	6.88	6.99	1.74	= 101.48

Near the village of Monchique a pegmatitic pulaskite or eleolite-syenite was met with, the only instance of a pegmatite discovered in the district.

The streaks (Schlieren) in the Picota rock are more acid than the body of the rock, one in the Foia area contains a hornblende of the katophorite-arfvedsonite series, otherwise they present no unusual features.

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[5] Min. u. Petrog. Mitth., XV, p. 466.

[6] Ib., p. 197.

One of the basic concretions in the Picota area has the composition of teschenite. Its analysis gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	CO_2	P_2O_5	H_2O	Total
49.67	4.14	14.56	6.09	6.41	4.66	14.87	4.25	1.94	.40	.52	1.18	= 100.82

Another is an essexite with the composition:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	Total
49.67	not det.	17.99	13.06		3.06	6.63	6.21	2.62	.86	= 100.10

The contact products formed in the surrounding slates, graywackes and quartzites are hornstones, knotty schists and other contact schists like those so frequently found around bosses of granite. Diabase hornstones (cordierite-bearing and cordierite-free) are contact facies of igneous rocks in the vicinity of the syenite intrusion.

Notes.—Jaggar[7] has constructed a simple instrument to use on the microscope stage for inclining a thin section in such a manner that optical axial angles may be observed in sections cut at random.

Merrill[8] continues his contributions to the study of rock weathering in a paper on the weathering of micaceous gneisses in Albemarle Co., Virginia. The results communicated confirm those obtained in previous investigations. The red color of the residual soil in this case, as well as in the south generally, is thought to be purely a superficial phenomenon. It is accounted for by the accumulation of the coloring matter distributed through the rock in the residue left by the weathering processes. Brilliant colors in residual soils are thus regarded as evidences of long continued weathering action. The author would limit the use of the term 'weathering' to the alteration "processes going on within the zone of oxidation and resulting as a rule in the destruction of a rock mass as a geological body." The deeper seated changes resulting in the alteration of the rock constituents without changing the character of the rock as a whole, he would term hydrometamorphism.

[7] Amer. Jour. Sci., III, 1897, p. 129.

[8] Bull. Geol. Soc. Amer., Vol. 8, p. 157.

GEOLOGY AND PALEONTOLOGY.

The International Congress returns to its proper mission.—The following is part of the last circular of the council of the International Geological Congress. One of the two specific objects which the Congress originally set out to accomplish was the modification of the nomenclature, but the meetings gradually drifted away from the work to the more entertaining occupation of listening to lectures by distinguished savants on various themes. The Council of the coming Congress recalls that body to its duty with abruptness, and reproduces the essential parts of the reports of the Committee employed to study the subject made at the Committee's sessions at Geneva and Manchester in 1886 and 1887.

If half of the questions here enumerated but receive the approval of the coming Congress, a boon will have been conferred on long suffering students.

Third Circular, International Geological Congress, 7th Session, Russia, 1897 :

The Committee of Organization of the 7th International Geological Congress has decided at its session of February 21st (March 5th) to dispose in the following manner of the time which the members of the Congress will pass at St. Petersburg between the 17th (29th) of August and August 23d (September 4th).

From 9 to 10 A. M., will be held the session of the Council of the Congress.

From 10 to 2 P. M., discussion [*in the Congress* Ed.] of the questions which will be proposed in the programme of the Committee of Organization.

From 2 to 3 P. M., visit to the museums and the exposition.

From 3 to 5 P. M., communications of a general character announced in advance to the Committee on Organization.[1]

It has been decided to group these communications in such a manner as not to embrace in a single day more than one of the branches of geological science.

After the session of the Congress it is proposed to make excursions in the environs of St. Petersburg. In the interval between August

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[1] Up to the present time several Geologists have expressed the desire to make communications of this kind.

17th (29th) and August 23d (September 4th) an excursion of one and a half days will be made to the cascade of Imatra.

As to the scientific questions which it is proposed to elucidate at the 7th Session of the Congress, the Committee on Organization has put itself in communication with Professors Capellini and Dewalque, President and Secretary of the permanent commission of the Congress (a commission charged with elaborating preliminarily the questions which it will be desirable to submit to the discussion of the Congress) as well as with several geologists of Western Europe and America.

In consideration of the answers received, the Committee on Organization has the honor to propose the following programme of the labor of the Congress.

On reviewing the work of the preceding Congresses, the Committee on Organization has observed that all the sessions which have followed that of London have lost sight of the propositions of the commission for the unification of the nomenclature, elaborated in the meetings at Geneva (1886) and at Manchester (1887), and announced by the Secretary of this commission in these terms:

"The commission on the uniformity of nomenclature thought it of importance before going further, to adopt certain principles of a nature to serve as a guide in the discussion of systems of classification, and it adopted the following theses."

"I. The divisions of the first order should have an universal value, and should be based upon paleontological characters sufficiently general to be applied to the whole earth."

"II. The sub-groups which are optional will be necessarily defined by the characters which are common to the systems of which they are formed. They should have an almost universal value." [In the thought of the commission these sub-groups were the Jurassic and the Cretaceous. The meeting at Manchester having rejected these sub-groups, this thesis II disappears from the programme].

"III. Besides the systems shall have a very general value. Their paleontological characters should indicate an organic evolution, particularly characterized by the study of pelagic animals."

"IV. In order that a division should be erected into a system, it is desirable that the succession of pelagic fauna show itself susceptible of well marked sub-divisions."

"V. The divisions of a system ought to have an European or equivalent value. Each stage ought to be characterized by a pelagic fauna sufficiently distinct."

"VI. The sub-stages can have but a regional value. (The commission thinks that the International Congress has not to concern itself with the final divisions which have only a local value)."

"VII. The divisions of the same order ought to present as much equivalence as possible from the point of view of the paleontological evolution which they represent."

"N. B. The commission recognizes that the geographical variations ought to be taken into serious consideration in the establishment of divisions of different orders; but on account of the frequently local character of the variations, and above all of the actual imperfection of our knowledge so far as relates to the old beaches, it thinks that the stratigraphical argument needs to be confirmed by the paleontological criterion."

At the Manchester meeting M. Hughes called attention to the necessity of discussing principles before the applications; on his motion the commission decided to ask the Congress to determine primarily the rules of stratigraphic terminology, such as the rules to follow in the historical and stratigraphical criticism, above all from the point of view of the law of priority.

The commission concludes its report with the following sentence:

"It seems evident that it would considerably shorten the discussions if the Congress proceed in this way."

Unfortunately the Congress of London could not profit by the sensible ideas enunciated at Geneva and Manchester, and was obliged to continue its labors in the direction imposed by the session at Berlin. Similarly the questions put by the commission for unifying the nomenclature were neglected at the Congresses of Washington and Zürich. Consequently it would be desirable that the Congress of Russia return to the questions having an international character, and that the decisions of the commissions of Geneva and Manchester that we have just cited (to which could be added some general theses) should become the basis of the questions to discuss.

The Committee on Organization of the Congress of St. Petersburg is of the opinion that before taking up the other questions, the Congress should decide primarily which of the two classifications it wishes to retain in the science, the *artificial* classification based solely on historical data, or the *natural* classification which bases itself as much on the general physico-geographical changes, common to the whole terrestrial globe, as on the faunal data, and not on the accidental limits of the different divisions called after the name of the region where they have been established for the first time.

The data actually at the disposition of science are sufficiently numerous to sketch the principal features of the great physico-geographical changes, such as the invasion of the oceans, the relations which exist between these and the general oscillations, etc. The reconciliation of these data with the faunal data could doubtless accomplish the admission of a new grouping of geological systems, and put an end to the continual fruitless polemics, which ensue from the efforts one is obliged to make in order to bring into the frame work of the actual systems all the peculiarities which the various regions offer. It goes without saying that the discussion of this question of a general nature does not exclude the necessity of examining the propositions of the commission for the unification of the nomenclature; but a satisfactory preliminary understanding would certainly contribute much to prepare the success of the deliberation on the propositions suggested by the commissions of Geneva and Manchester.

After the examination of the first points it would be very desirable that a second question of principle should be cleared up, that of the rules to follow in the introduction of new terms in stratigraphic nomenclature. Each of us knows how many new denominations appear in the literature to designate different geological divisions. Frequently the authors of the new terms introduce them without any argument, either batrological or faunal, which might serve to distinguish clearly the sediments to which they apply these denominations from the adjacent deposits; it happens even sometimes that the authors themselves have very vague conceptions of what they call by a new name. Such neologisms appear not only in the special literature, but quite frequently in the manuals, whence they pass into the general literature. These new terms being evidently but a useless burden to the science, it is in the highest degree desirable that the Congress, which has already established rules to follow in the paleontological nomenclature, assert itself also on the question of the stratigraghic nomenclature, and that it establish data which may authorize the application of new denominations to certain deposits.

Another question of not less absolute necessity in the opinion of the Committee on Organization, is that of petrographic nomenclature, of which it is more than urgent to-day to establish the principles.

The inundation of new terms in the science has attained such dimensions that very soon no human memory will be able to retain the whole mass of new denominations, and the reading of each memoir will necessitate the employment of a special glossary. The labors undertaken in this direction could be made simultaneously with the deliberations on the principles of petrographic classification, of which the elaboration has been confided by the Congress of Zürich to a special commission under the presidency of M. A. Michel-Levy.

The Committee on Organization of the Congress of St. Petersburg does not flatter itself that the single session from August 17th (22d) to August 23d (September 5th) will suffice to exhaust this programme, but if it be only a part which can be submitted to discussion from all points of view—a discussion which would offer to the Congress the possibility of expressing itself in a definite sense, the 7th Session of the International Geological Congress would still have the merit of having directed the labors of the meeting in the right road, abandoned since the session at Washington.—P. F.

On the Laramie and Related Formations in Wyoming.—Various questions that have arisen in regard to the contents of the Laramie formations have been investigated by T. W. Stanton and F. W. Knowlton. They show that the Black Buttes (Wyoming) beds are true Laramie, and correlate with them the Ceratops beds of Converse County. The plant forms confirm the Laramie age of the Ceratops beds. It is also demonstrated that the coal-bearing series of the Laramie plains in large part if not wholly, are older than the true Laramie. The facts stated by the writers lead them to follow the example of King, Hayden and many other geologists in placing the base of the Laramie immediately above the highest marine Cretaceous beds of the Rocky Mountain region. They include in the Montana formation or division intercalated non-marine beds that at some localities yield land plants and brackish and freshwater mollusks as well as coal.

The discussion of the upper limit of the Laramie is replete with interest and is here given in full :—

" Until a few years ago it was the custom to include in the Laramie all of the beds between the Fox Hills and Wasatch formations. In the Denver region the detailed studies of Cross and Eldridge,[1] have resulted in the recognition of the Arapahoe and Denver beds separated from the Laramie and from each other by unconformities and distinguished by marked lithologic features. A revision of the fossil floras of that region has also shown that the Denver beds contain a flora composed of species, a large proportion of which are not found in the underlying Laramie. Cross,[2] Hills[3] and others have observed that beds lithologically resembling the Denver bed and in a similar stratigraphic position above the Laramie, occur at several widely separated localities in western and southwestern Colorado. In southern Montana Weed[4] has defined the Livingston formation as a very thick series of strata lithologically comparable with the Denver beds, resting unconformably on the Laramie and yielding a small flora more closely related to the Denver flora than to any other. The same geologist[5] also finds beds that he refers to the Fort Union, overlying the Livingstone. All these formations are older than the Wasatch, and we should naturally expect to find them in eastern and southern Wyoming, or, if they are absent there, their places should be indicated by unconformities.

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[1] Proceeds. Colo. Sci. Soc., Vol. III, pt. I, pp. 86–133; Amer. Jour. Sci., 3d Ser., Vol. XXXVII, 1889, pp. 261–282; Monograph, XXVII, U. S. Geol. Survey (in press).

"The Denver and Arapahoe beds have yielded representatives of a remarkable reptilian fauna consisting largely of horned dinosaurs of the family Ceratopsidæ. The presence of this family in the Ceratops beds of Converse County and probably at Black Buttes has suggested the very reasonable query whether the beds containing them at these places also are not younger than the true Laramie. The facts we have presented relative to the stratigraphy and paleontology of the Black Buttes dinosaur horizon seem to us convincing that it is in the Laramie and near the base of that formation. It is less than 200 feet above the marine Cretaceous, and there is no evidence of a break[6] nor any abrupt lithological change. The character of the flora and of the invertebrate fauna also, so far as the species have a distribution in recognized horizons elsewhere, favors its reference to the Laramie. If the Dinosaur bed of Black Buttes is not Laramie, then the Laramie is either absent or is represented only by about 100 feet of sandstone. The overlying beds up to and including strata with a Fort Union flora seem to form a continuous series that is indivisible either structurally or lithologically, and we can see no reason for placing the top of the Laramie lower than the base of the lowest bed with a Fort Union flora.

"Closely similar conditions are seen in Converse County, the principal difference being a greater development of the beds. The sandstones at the base overlying the Fox Hills are a few hundred feet thick, and the variable, more argillaceous higher beds, with a fresh-water fauna in large part identical with that at Black Buttes and a flora that also indicates the same horizon, have a much greater thickness. Here again there seems to be no break in a series that has Fort Union plants in its upper member. The abundant occurrence of such a species as *Campeloma multilineata* throughout all but the lowest portion of the series argues strongly for continuous sedimentation.

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[2] Amer. Jour. Sci., Vol. XLIV, 1892, pp. 19–42.

[3] Proceeds. Colo. Sci. Soc., Vol. III, pt. III, 1890, pp. 390–397.

[4] Bull. U. S. Geol. Surv., No. 105, pp. 21--37.

[5] Amer. Geol., Vol. XVIII, pp. 201--211, 1896.

[6] The supposed unconformity between Powell's Point of Rocks and Bitter Creek groups has no bearing on this question, since it is below marine beds belonging to the Fox Hills.

"The difficulty of recognizing unconformities in beds so little disturbed has not been overlooked, and the possibility that there may be such undiscovered breaks in these two areas is freely admitted, though it does not seem to us probable. From the facts now available it seems most probable that in Converse County, and in the Bitter Creek Valley, the time representatives of the Denver and Arapahoe beds are undifferentiated portions of a continuous series, and cannot be sepated from the Laramie. The Fort Union beds are apparently distinguishable by means of their flora, and these mark the upper limit of the Laramie in the areas in question." (Bull. Geol. Soc. Amer., Vol. 8, 1897).

A Comparison of European and American Lower Cretaceous Flora.—In comparing the fossil floras of the Lower Cretaceous beds of America with those of Europe, Dr. Lester Ward finds some close analogies existing between them. The European beds examined are the Wealden of England, the Scaly Clays of Italy, and the Lower Cretaceous of Portugal; the American floras used for comparison are those of the Older and Middle Potomac, the Trinity of Texas, and the Kootanie of the northwest. The table of the distribution of the Wealden flora compiled by Dr. Ward shows that the paleontological relations between the Wealden of England and the Potomac formation of America are as close as are the geological relations.

In regard to the Scaly Clays of Italy, the author is inclined to favor their Lower Cretaceous age from the general resemblance of the Cycad remains of the formation in question to those of America. Both the stratigraphy and the faunal remains confirm this view.

Lastly, the author finds that the Lower Cretaceous of Portugal is, botanically speaking, a close repetition of that of America. (Extr. Sixteenth Ann. Rept. U. S. Geol. Surv., 1894–95. Washington, 1896).

Geological News.—ARCHEAN.—The iron ore bodies in and near Mineville, N. Y., constitute the third largest single group developed east of Lake Superior. They occur on the contact between gabbro and gneiss. A study of the relations of the rocks leads Mr. J. F.

Kemp to the conclusion that the gabbro was intruded as one or more sheets which pierced the gneisses parallel with the present direction of foliation. Subsequent to the intrusion and to the ore deposition came the dynamic metamorphism which developed the gneissoid foliation. The ore deposition, the metamorphism and the folding are of pre-Cambrian date, but some faulting is probably later. The author regards the ores as contact deposits formed by the influence and stimulus of the gabbro intrusion. (Trans. Amer. Inst. Min. Eng., 1897).

PALEOZOIC.—The affinities of the perplexing genus Vertebraria have been finally settled by M. R. Zeiller. Among the collection of plants obtained by M. de Launay from the permo-triassic deposits of the Transvaal, were a number of specimens of Vertebraria, which upon minute examination showed not only the rhizome structure, but also that the rhizome consisted of a central axis with a variable number of longitudinal wings anastomosing two by two from place to place. This suggested to the investigator that Vertebraria belonged to the Glossopteris. Other specimens verified this conjecture by permitting the tracing of a group of bundles starting from the anastomosis of longitudinal ridges into the midrib of a Glossopteris leaf. Vertebraria is, therefore, the rhizome of Glossopteris. (Records Geol. Surv. India, Vol. XXX, 1897).

MESOZOIC.—A small collection of plants from the Cretaceous marl at Cliffwood, N. J., is reported upon by Professor Hollick. The remains number 26 species, of which 10 are new ; the latter are described and figured. Conifers are the most abundantly represented. This collection is of interest as supplementing our previous knowledge of the Cretaceic flora of eastern North America. (Trans. New York Acad. Sci., 1887).

CENOZOIC.—Dr. George Dawson reports the finding of *Globigerina cretacea* and *Textularia globulosa,* as well as other forms of marine organisms in the boulder clays of the Great Plains which appear to be contemporaneous with the deposition of the clays. This fact corroborates the author's previous suggestion that the water covering the western plains at this time may have been at the level of that of the sea and in more or less direct communication with it. (Journ. Geol., Vol. V, 1897).

The evidence thus far gathered concerning the petroleum yielding rocks of California leads to the following conclusions:—

(1) That the Oligocene and Eocene formations contain a primary deposit of petroleum.

(2) Secondary deposits consisting of asphaltum, have a vertical range from Miocene to Pleistocene. (Calif. State Min. Bur. Bull. 11, [1896] 1897).

BOTANY.[1]

A Scientific Dictionary of Plants.—Of unscientific dictionaries of plants we have had many, but at last we have one which may be consulted without fear by the scientific botanist. It is so useful that we may well call attention to it here. Its author, J. C. Willis, is the Director of the Royal Botanic Garden in Ceylon, and the book, which he calls "A Manual and Dictionary of the Flowering Plants and Ferns," is the outgrowth of his experience in garden, museum and field. In the first volume are given summaries of Morphology, Ecology, the Principles of Classification, Geographical Distribution, and Economic Botany. The second volume, which is double the size of the first, consists of an alphabetical arrangement of classes, orders and genera, each with valuable descriptive and numerical data.

In the preparation of the work the author has made use of Engler and Prantl's *Pflanzenfamilien*, thus insuring a modern treatment. The fact that it is brought out by the Cambridge University Press as one of the Cambridge Natural Science Manuals, is a sufficient guarantee of the mechanical excellence of the work.

—Charles E. Bessey.

Order and Family in Botany.—It has been a well-recognized law in Zoology that "Family" is a subdivision of "Order," and in many botanical publications an effort has been made to recognize the same relation. It is very unfortunate that in the ordinary English books both of these terms have been applied to the same groups. Thus we have Order *Ranunculaceæ* and Family *Ranunculaceæ*, Order *Compositæ* and Family *Compositæ*. Here we throw away a much needed group-term, and are obliged to bring in the term "Cohort" to replace it, to say nothing of "Series" and "Division." Some of the German botanists have wisely followed the zoological practice of using "Order" for a group above "Family." Thus Luerssen (*Handbuch der Systematischen Botanik*), Sachs (*Text-book of Botany*), Goebel (*Outlines of Classification and Special Morphology of Plants*), Schumann (*Lehrbuch*

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[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

der Systematischen Botanik) Winter, Luerssen, Limpricht and others (*Rabenhorsts's Kryptogamen Flora von Deutschland, Oesterrich und der Schweiz*), Schroeter (*Die Pilze Schlesiens*) and Engler and Prantl (*Die Natürlichen Planzenfamilien*) group the families (*Familien*) under orders (*Ordnungen, Reihen*). Over against this commendable practice we may contrast the common English and American manuals, as Hooker's *Student's British Flora*, Bentham's *Handbook of the British Flora*. Gray's *Manual of Botany*, Coulter's *Manual of Rocky Mountain Botany*, Watson's *Botany of California*, and Bentham and Hooker's *Genera Plantarum*, in all of which Order and Family are treated as synonymous terms. Now and then we find a work in which these terms are treated as not synonymous, but, curiously, Family *is placed above Order*. Twenty or more years ago, Cooke, in his Handbook of British Fungi, used these terms in this reversed relation; but little was thought of it since he never paid much attention to such details. Recently a work has appeared (Warming's *Handbook of Systematic Botany*, translated by Potter) which is so useful in many ways that it must be widely used, in which the orders are made secondary to the families. Thus we find the "Family" *Gasteromyceteæ* containing the "Orders" *Tylostomaceæ, Lycoperdaceæ, Sclerodermataceæ, Nidulariaceæ* and *Hymenogastraceæ*, the "Family" *Saxifraginae* containing the "Orders" *Crassulaceæ, Saxifragaceæ, Ribesiaceæ, Hydrangeaceæ, Pittosporaceæ, Hamamelidaceæ, Platanaceæ* and *Podostemaceæ*. We hoped that this confusion would find no foothold in America, but we observe that Thaxter in his great *Monograph of the Laboulbeniaceæ* follows the undesirable practice by subdividing the Family *Laboulbeniaceæ* into three "Orders."

It should not be necessary to argue for uniformity of practice in the two branches of Nature-study, Botany and Zoology; that appears to be almost self-evident; but these later exceptions show that there is danger that we shall have more and more cases of violation of the rule. It is not a matter of small moment. It is not true that botanists may be a law unto themselves in such matters. Every man, however much he may have deepened his work until he may be said to have mastered some particular field of the science, must remember that to a large extent his work must be followed and reviewed by men who, for a time, at least, work in more than one field. Every biological student has a right to demand that specialists shall not add needlessly to the difficulties which confront him in his attempts to gain a knowledge of the scientific grouping of plants and animals. So long as the botanists used "Order" and "Family" indifferently for the same groups, the student had little difficulty in remembering the curious fact that while botanists have as great a need as the zoologists for group-terms, they have thrown away "Family" by making "Order" synonymous with it and then using both terms for the same groups. When, however, he faces the fact that in zoology the sequence is Class, Order and Family, and in botany Class, Family and Order, he may well become indignant at the want of agreement between the workers in these nearly related fields of science.—CHARLES E. BESSEY.

Botanical Notelets.—Frank Vincent's "Plant World" is a pleasantly written book in Appleton's Home Reading Books. It consists of selections, prose and poetic, relating to plants. In general these selections are judiciously made, but there is one at least written by I. Platt in "The World's Encyclopedia of Wonders and Curiosities" which should at once be suppressed by the publishers. How Dr. Harris, the editor of the series, could have allowed such arrant nonsense to go into this otherwise excellent book is quite inexplicable.

Of some botanical interest is the pretty little book, "The Dahlia," edited by William Cuthbertson, and published by Macmillan & Co. While primarily intended for gardeners and florists, there is not a little of value in it for the scientific botanist who is interested in the question of the pliability of plants under man's hand.

J. B. Leiberg's report of his botanical survey of the Coeur d'Alene Mountains, Idaho, in the summer of 1895 (Contrib. U. S. Natl. Herb., Vol. V, No. 1), brings to light many interesting facts about a relatively little known region. It contains many suggestions as to the policy of forest preservation in which so many scientific men are now interested. It is interesting to note that in spite of the fact that this report has a marked economic flavor, all measurements are metric throughout. Certainly if the United States Department of Agriculture can safely use the metric measurements in a bulletin dealing with topography, drainage, climate, mineral deposits, agricultural capacity, agricultural products, grazing lands, native food plants, utilization of water supply, forest resources, forest destruction, forest preservation, etc., botanists need no longer fear to make use of such measurements in their books, even of the most popular character.

The last number of Pringsheim's *Jahrbücher für wissenschaftliche Botanik* (Bd. XXX, 2 and 3), now edited by Pfeffer and Strasburger, is remarkable for the richness of its contents, the whole being devoted to cytological studies from the Botanical Institute of Bonn. After an introductory note by Strasburger there are papers on the karyokinatic spindle of Equisetum (Osterhout), nuclear division in the pollen-mother-cells of certain Dicotyledons and Monocotyledons (Mottier), nuclear division in the pollen-mother-cells of *Hemerocallis fulva* (Juel), nuclear division in *Chara fragilis* (Debski), nuclear division and free-cell-formation in asci (Harper), nuclear division and fertilization in *Basidiobolus ranarum* (Fairchild), nuclear- and cell-division in the *Sphacelariaceæ* (Swingle), nuclear division and fertilization in *Fucus* (Strasburger), cytoplasm-structure and nuclear- and cell-division (Strasburger), fertilization (Strasburger). It is encouraging to observe the names of the American botanists, Osterhout, Mottier, Harper, Fairchild and Swingle in this list.—CHARLES E. BESSEY.

ZOOLOGY.

Stichospira paradoxa.—Nov. gen. and sp. of *Ciliata Infusoria* with plate.—Body, when extended, much elongated, consisting of a bulbous posterior part, a long, slender neck, and an anterior part with the peristome and a long corkscrew-like anterior extension curved dorsalward and to the right, bearing the prolongated adoral zone of cilia. When contracted, it is obovoid with the anterior end rather pointed. The substance of the body is slightly yellow. One contractile vacuole is situated in front of the peristome, somewhat to the left and dorsalward, another near the posterior end of the body. Two almost globular endoplasts were seen not very distinctly. In the posterior part there are, as a rule, numerous food-balls and small, strongly-refracting particles. On the right margin of the rather deeply excavated peristome is a broad, thin, hyaline membrane, standing out perpendicularly, ventralward; it appears to be rather stiff and is undulating very slightly (*u m* in fig. 2.). The anus is in the anterior part, to the left of the peristome, and constant. Of cilia there are the following:—

1. The adoral zone with about 30 to 50 transverse series of fine, long cilia from the peristome-angle to the anterior end of the processus, of which this zone is occupying the outer side.

2. One single, stronger, shorter cilium at the anterior end of the zone, and sometimes a smaller one in front of it.

3. A series of about 20 " paroral " cilia just inside of the membrane on the right peristome-margin; they are long, bristle-like, crowded, appearing stiff, but slightly vibrating, longest in the middle of the series, their ends forming a regular curve.

4. "Endoral" cilia lining the gullet from the peristome-angle through the neck to the posterior part.

5. A right marginal series extending from the anterior end to and over the neck; the cilia are rather short and somewhat remote from each other.

6. A left marginal series, beginning to the left of the peristome and extending backward, somewhat oblique; the cilia are short and crowded.

7. Two series of ventral cilia on the neck, between 5 and 6, and posterior to the peristome.

8. A short, oblique group or series of about six long, hair-like, stiff cilia, to the left and somewhat behind the peristome-angle, directed ventralward obliquely.

9. A longitudinal series of cilia of the same kind along the left side of the neck.

10. A similar series on the right side; in both these series the cilia are directed slightly backward when the animal is extended, and forward when it retracts.

11. Fine, stiff, hair-like dorsal cilia or "tactile hairs," in several series of various length; quite short on the anterior processus, longer from the peristome backward; Nos. 9 and 10, and possibly, also, 8, may be of the same category.

12. Some cilia near the posterior end of the body, whose exact grouping and significance are yet to be ascertained.

The size is subject to considerable variation; long. of extended specimens 0·15–0·25 mill.

It seems that the anterior part and neck are made up wholly of ectosarc, and the softer endosarc fills the posterior bulbous part.

The food consists of smallest particles, so far as observed, most bacteria, etc., carried along with the current of water and gathered in the gullet at some distance from the peristome-angle, to a smaller or larger ball (fig. 1 *f b*) which is then passed backward. By the large membrane and the long, dense series of long "paroral" cilia at the right margin of the peristome (fig. 2, *u m* and *par*), standing out perpendicularly, a very effective wall is formed for conducting the current with the minute food particles to the peristome-angle. Larger objects are usually expelled when driven into the peristome, by the posterior adoral cilia directed rather towards the right. But occasionally larger morsels, up to 0·01 mill. diameter, are swallowed. After digestion, the balls (fig. 1, *d b*) are passed forward through the neck, on the left side, to the anus (fig. 1, *a*) situated to the left of the peristome. While passing along the neck they project considerably over the general level, and seem to be covered only by the cuticula. The anus has its constant place, but is marked by a slight irregularity of the surface only for a short while after the waste ball is ejected.

The animal lives, as a rule, in a cavity of some plant, a living or dead leaf, etc., from which it projects, straight, or curved, at any suitable angle. Very often this dwelling is extended forward by the addition of a tube (fig. 1, *t*) built by the animal itself with small particles of different materials carried along by the current, connected, probably, by some mucus secreted from the body. Sometimes these tubes are rather hyaline and transparent, containing few foreign bodies. Occasionally a specimen is seen in a tube made up entirely by itself. From the cavity or tube, the anterior part of the body is projecting, when extended, to a short distance behind the peristome-angle (usually less so than in fig. 1), while the posterior part is, as a rule, not or very indistinctly visible.

When the animal is emerging from the tube, its anterior part is quite straight, the adoral cilia along the ventral side laid together, directed backward, and resting or vibrating very slightly, as a rule (fig. 4). Then, all at once, they spread out and begin vibrating vividly, and at the same time the anterior processus suddenly turns into the corkscrew-shape, like a spring. Thus extended the animal will keep for a shorter or longer time, in the way of Vorticellidæ, often swaying to and fro, or turning around its axis, and then as suddenly it will retreat deep into its cavity, where it may remain for a few seconds, or minutes, up to several hours, and sometimes probably more. At times an animal may be seen slowly advancing in its tube, about to the aperture, then slowly retreating, and continue doing so for a good while, with the cilia, especially the posterior adorals, slightly vibrating. Possibly this is done for the purpose of respiration.

As already stated, there is considerable variation in size. Each individual is growing, but slowly, even with abundance of food. With the growth of the animal is connected a considerable increase in the number of adoral cilia, as well as probably of some other groups. This is a fact not sufficiently noticed, so far, as to my knowledge, and with it we meet a question of highest interest concerning not only the form under consideration, but all Oxytrichidæ and related groups.[1] It is more than probable that the new rows of cilia are formed at the anterior end of the adoral zone, which is corresponding with the right or aboral end in other groups, for the following reasons: 1. The transverse rows in the adoral zone are always equal and equidistant, so that a new formation between the existing rows is excluded. 2. The foremost rows are short, bearing only a few cilia each; with the increasing size of the animal they become longer, bearing also a greater number of cilia, i. e., the adoral zone grows wider, while at the same time the number of transverse rows is increasing from about 25 or 30 in all, about 18 in front of the peristome, to about 50, or 30 respectively. Thus the foremost rows in a small specimen will be about in the middle of the processus when the animal has become large. 3, In several instances it seemed that the single, shorter, stronger cilium in front of the adoral zone (*c*) was split into two or three filaments, at its end, and so it is probable that it represent and grow out into a newly added transverse row, the more so as a smaller cilium was often seen in front of it, which subsequently would take its place (*c'*, fig. 4).

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[1] It should be borne in mind that in *Oxytrichidæ*, *Euplotidæ*, *Halteria*, etc., in the *Heterotricha* of Stein, in *Amphileptus* and some others (which should range with the Heterotricha), the adoral zone does not consist of a spiral or longitudinal series of single cilia, but of transverse rows of such, each one in the shape of

A group of rather crowded, short cilia is at the anterior end on the right and dorsal sides, evidently the new additions to the right marginal series and the fine, stiff dorsals or "tactile hairs" (see figs. 1, 2, 4, 5, 6).

Binary fission has not been observed directly. To all probability it is going on during retreatment. Many specimens have been rather closely observed during several—up to four—days in succession without any changes indicating fission being noticed on the anterior part, except in size and the number of adoral transverse rows. Lately two animals were seen, side by side, growing to a large size, during three to four days. Both of them were in normal shape, at noon, one day; when seen again, about an hour and a half later, both had changed: the anterior part was shorter and smaller, the end looked as though chopped off, the number of transverse adoral rows was only about 18 in front of the peristome; the cilia were short and showed that peculiar, slow vibration always seen on new cilia during and just after fission in Oxytrichidæ and all ciliates bearing an adoral zone. Evidently they had undergone transverse fission. On the following day both specimens again presented a different appearance (fig. 6): the anterior end was

a fan when spread out. In innumerable instances this was distinctly seen in many species of the different groups named, while the animals were living and in normal condition. Whether the cilia in the transverse series are always separated down to the base, or are coherent so as to form a kind of short "membranelles," may still be an open question.

somewhat club-shaped without any adoral cilia for some distance, but with the single, larger cilium (*c*, No. 2, above) and a group of rather crowded, short, fine cilia on the back. Later, both were of normal form, and again, two days later, the same club-formation was noticed on one of them. These were the only instances where this form was seen, and it is impossible to judge, at present, whether it was an incidental, abnormal formation, or one occurring regularly during growth; yet the former is more probable.

There is one somewhat peculiar and interesting feature about the fission in our species: In almost all other ciliates the two newly formed individuals are of about equal value, even in the Peritricha. In *Stichospira* the anterior animal evidently leaves as soon as separated, while the posterior remains in place in its dwelling. Here, then, fission seems to approach, in a certain degree, gemmation.

Several times specimens were seen free and contracted in the shape shown in fig. 3. Whether they were anterior individuals formed by fission, or such that had been thrown out of their cavities, accidentally, remained in doubt. Both assumptions may be true. On such animals a few cilia, of common form, were seen near the posterior end of the body (see No. 12, above, and fig. 3, *cp*).

From the description and figures it is apparent that *Stichospira* is a ciliate of very peculiar organization. In the formation of its anterior part it resembles the Oxytrichidæ, with which it is to be ranged, but representing a group of its own, owing to the formation of its middle and posterior parts and the mode of life. With the latter moments it resembles, to a certain degree, some heterotrichous and peritrichous ciliates. It may also be said that the highly differentiated apparatus of cilia in the anterior are in a strange contrast with the simple, sack-like posterior part produced by and adapted to the animals's living in a cavity or tube; that is to say, for a form of Oxytrichidæ. And in this connection, the situation of the anus, in the anterior part of the body, is also very significant. This is an exceedingly illustrative example, and rare to such a degree among ciliates, of the mutual impressions of organization and mode of life.

It must be added, however, that the organism under consideration is not without its analogies and homologies. On the one hand, it has much in common with *Freya*, and in a similar way with *Amphileptus*, etc., by the forward extension of the anterior part with the adoral zone in front of the peristome. On the other, it is nearly related with *Stichotricha acuminata* Pty., for which species the first examples seen were erroneously taken, and in allusion to which the generic name was given to our form. Later I had a chance to observe the two species side by side. In *Stichotricha*, likewise, the anterior part is much prolonged, the hair-like cilia are highly developed, and, as it seems, they serve not only for "tactile" purposes, but rather, at least in *Stichospira*, and very probably also in *Stichotricha*, for guiding and directing the various particles passing along with the current of water, partly to be arranged to the tube built by the animal itself, as *Stichotricha* has also the inclination to, at least temporarily, live in cavities or self-made tubes. *Stichospira* must be regarded as a very much differentiated form of the same type, representing a different genus and even group.

The animal was first noticed in March, 1894, when about a hundred specimens were seen, from a small but healthy aquarium kept since early fall. Yet some points of the organization and life-history remained in doubt, and thus publication was deferred. Since May of that year, none were seen until recently, when again several dozen came under my observation, also in an aquarium, in company with many other ciliates, mostly living on, or rather in, small, old stems of Riccia. The observation and examination of this Infusorium presents its peculiar difficulties, as is apparent from the description. Thus, of conjugation and the forming of cysts, nothing has been seen; yet a publication seemed to be not out of place.

EXPLANATION OF THE FIGURES.

t	tube.
c v	contractile vacuoles.
e	endoplasts, or "nuclei" (fig. 3).
p	peristome.
r p m	right-peristome-margin.
l p m	left " "
g	gullet, lined with endoral cilia.
f b	food-ball in the gullet.
b	food-balls in the posterior part of the body.
d b	digested and waste food-ball passing to the
a	anus.
u m	undulating membrane.
a d	adoral cilia.
c	single cilium at the anterior end.
c'	additional smaller cilium.
p a r	paroral cilia (fig. 2) in a dense series.
r m	right marginal series of cilia.
l m	left " " " "
v	"ventral" cilia.

PLATE XV.

c
ad
1
ad
d
p
rpm
ad
cv
u
rm
dt
lm
g
h
fb
lh
rh
t
g
b
cv
c
2
ad
d
ad
par
cv
lpm
um
h
d
lm
v
g
c
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c
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4

Stichopira paradoxa Sterki.

h group of long, hair-like cilia to the left of the peristome.
r h series of such cilia along the right side of the neck.
l h the same on the lest side.
d "dorsal" cilia, or "tactile hairs," short on the anterior part of the body, longer from the peristome backward.
c p some cilia near the posterior end of the body.

Fig. 1. Specimen seen from the ventral side, with indication of the tube built by the animal, from which it is projecting more than usually; the cavity in which the posterior part rests is omitted. On the right margin of the peristome (*r p m*) the membrane and the paroral cilia (*u m* and *p a r* in fig. 2) are not, or very indistinctly, visible in this position. The adoral cilia are only indicated by one at the end of each transverse row (conf. figs. 5 and 7).

Fig. 2. Anterior part viewed from the left side. The adoral zone is seen directly in front of *l p m*, through the projecting margin behind *l p m*.

Fig. 3. Contracted specimen, not in cavity; sketch. Others seen were of somewhat different shape.

Fig. 4. Anterior end of animal just emerging from its tube. Adoral cilia laid together and directed backward, resting; the lines indicate not the cilia, but the spaces between the transverse rows.

Fig. 5. The same, with the adoral cilia somewhat diverging.

Fig. 6. The same, as seen in specimens sometime after fission, the adoral cilia are only indicated.

Fig. 7. Single transverse row of adoral cilia, more magnified.

Scale of figs. 1 to 6, × 500. —Dr. V. Sterki.

New Philadelphia, Ohio, March, 1897.

The "Urnes" and the Enigmatic Bodies in the Body-Cavity of Sipunculus.[2]—For some time the existence of certain peculiar bodies in the body-cavity of *Sipunculus* has been known. What their nature is has been a disputed question. Vogt and Young and Fabre-Domerque, influenced by the mobility of the bodies, have thought them autonomous, and have compared them with parasitic ciliated infusoria. Others, among whom must be mentioned Brandt, Ray-Lankester and Cuénot, have considered them as epithelial elements that have become free, and as belonging to the organisation of the animal. They have thought that all the transition stages between the simple ciliated epithelial cells of the intestine and the free urnes may be found.

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[2] J. Kunstler and A. Gruvel. Recherches sur l'évolution des Urnes. Comp. Rend., CXXIV, 309–12.

Kunstler and Gruvel assert that the bodies have a different history, and, if the correctness of their observations be granted, we must give up the conclusions that we have supposed well-founded and return to the ideas of Vogt and Young and Fabre-Domerque and consider the bodies as autonomous organisms. But, if they are such, the question arises, What can be their history in the cavity of the young *Sipunculus*, how did they gain entrance, and from whence did they come?

According to these authors the urne is the final stage in a series, and represents the form of the organism or element that is most common. This element becomes flattened and enlarged in its ciliated region, while its hyaline vesicle looses its spherical form. As a result of the change of form, there is produced a large disc having waving movements. While these changes are taking place there appear in the lower side of the disc numerous cellular elements that soon become free and function as reproductive bodies.

The latter have been known under the name of amœbocysts. They are generally provided with numerous long and thin pseudopodia, and sometimes structures resembling undulating membranes. Their granular protoplasm contains two bodies, one colorless, the other dark, that resemble nuclei. In the course of growth the colorless body increases in size faster than its dark companion, and finally escapes from its containing element. There is thus left an element having pseudopodia, and containing a small dark colored body. The pseudopodia become more numerous and smaller, and somewhat later some of them become flagellate at the peripheral zone. They are then minute urnes that soon, by the simple process of growth, become urnes of the normal size.

Besides the urnes and their reproductive modifications, there may be found, in the liquid of the body-cavity of *Sipunculus*, certain bodies that, evidently for want of a better term, the authors call enigmatic vesicles. To a certain extent, these resemble the urnes. By the simple process of fission they produce large cellular plaques composed of two layers of cells or elements. An application of staining reagents to these brings out marked differences. Some of the elements stain readily and deeply, others appear to be scarcely stainable.

In the course of time the clear elements become isolated, repeat the process of division and in their turn produce plaques. The other elements give rise to buds that are nucleated and provided with a hyaline vesicle. The attaching pedicle of the bud becomes greatly lengthened and finally breaking away the bud becomes a free, large amœboid body, with waving pseudopodia and within which one may recognize clear and dark colored vesicles in different stages of development that later function as reproductive elements.

Sometimes the normal urnes may reproduce by the simple process of fission, the two halves drawing apart. At such times one may find buds developing upon the large clear vesicle that seem analogous to those just described.

The authors promise a memoir accompanied with micro-photographic plates.

Biological Observations on Peripatus.[3]—The observations which Mr. Steel makes upon a large number of specimens of *Peripatus leuckarti* var. *orientalis* Fletch. are of considerable biological interest. Some 579 specimens, 390 of which were females, were collected in New South Wales during the seasons 1894–5–6. He found that the color of individuals is quite variable, but that the variations are such that they may be arranged in four groups: first, those which are blue-black or black, of which the total number of specimens contained 77.5 per cent.; second, black specimens, speckled with brown, which numbered 6.5 per cent.; third, brown specimens with black antennæ, which amounted to 10 per cent.; fourth, specimens entirely brown, of which there were 6 per cent. These colors, he states, seem to be more or less fixed, for, as a rule, the larvæ follow the color of the mother; for example, brown specimens with black antennæ will produce young with the same color characteristics.

Considerable difference was noted between the sizes of the specimens collected in the season of 1894–5 and of those collected in the season of 1895–6. The latter were very small in comparison with the others. The specimens were also rarer during the latter season. The author endeavors to account for these differences by citing the fact that the first season was moist and the second very dry. But whether the large specimens of the first year had died off, or whether the unfavorableness of the second season had decreased their size, he is unable to say.

The food of Peripatus consists entirely of insects such as those found on and beneath decayed logs, and of these the Termites seem to form the animal's favorite food. The animals are sociable and gather in groups and give no evidence whatever of being cannibalistic. The author has fed the animals in vivaria upon dead insects, but has never been able to induce them to eat raw meat.

When surprised by a quick exposure to light, they sometimes eject slime from their cephalic glands, and when seeking prey, if the latter struggles considerably or is likely to escape, the slime is ejected upon it for the purpose of quieting its struggles. In doing this the animal raises its head and the anterior portion of its body from the ground and ejects the slime strongly in two small streams for some distance. The slime is not acrid, is tasteless, and in is no way irritating to human mucous membranes; but it is very viscid.

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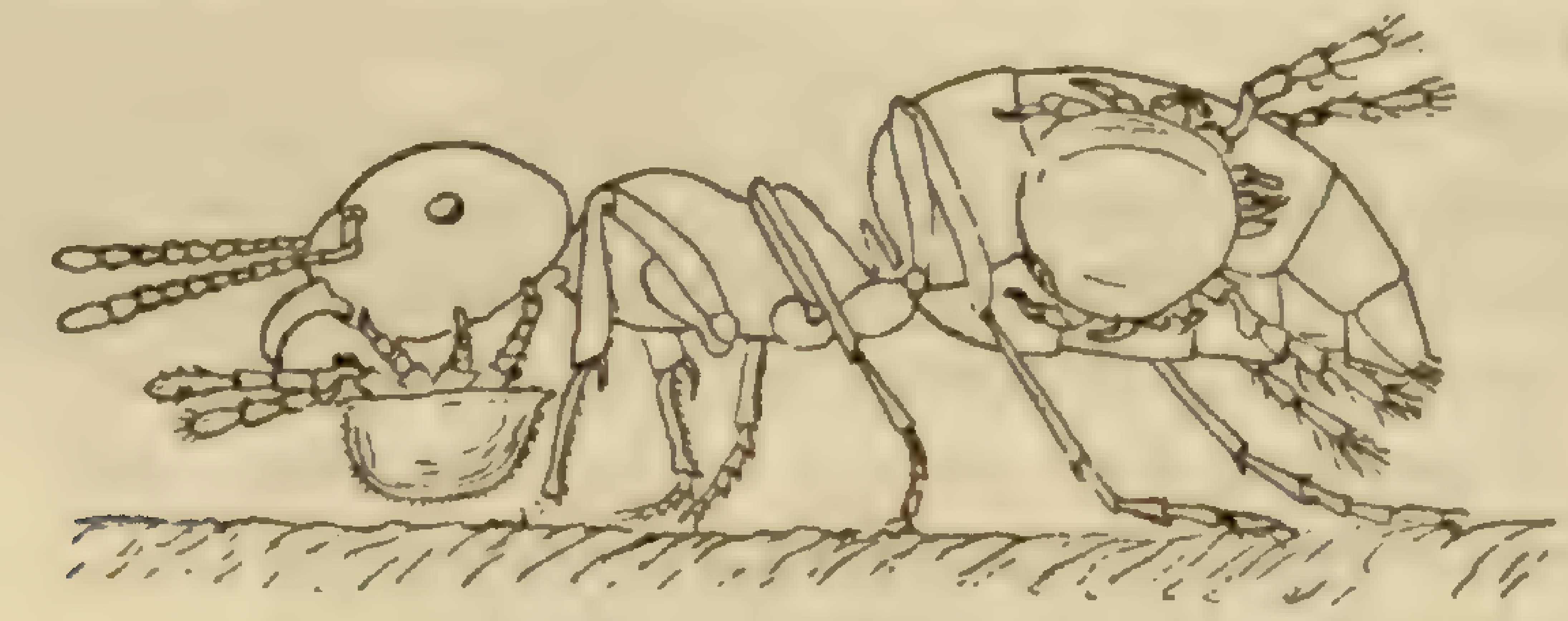
[3] Thos. Steel. Observations on Peripatus. Proc. Linn. Soc. N. S. Wales., XXXI. 97–104.

The animals cast their skins at regular intervals, very much as do insect larvæ, and the cast skins are usually worked over with the jaws of the animal and swallowed.

The young are born at all times from the middle of November to the middle of March, and are about five millimeters long at birth. Growth takes place at the rate of about one millimeter per month, and from the latter fact the author concludes that the animals must be about two years old when full grown, and from other observations he thinks they must be three years old when they first give birth to young. External parasites have not been found.

A Myrmecophlous Mite.—The brief note by C. Janet[4] on the Mite *Antennophorus uhlmanni*, recalls, one noted some time ago on the relations of *Lepismina polypoda* to ants. This mite is found living as an epizootic parasite on *Lasius mixtus*. Often there is but one parasite to a worker ant, but sometimes there are more, as shown in the figure.



In any case the mites arrange themselves on the host with reference to the median plane of the latter so as not to disturb its equilibrium. If there are two parasites, they occupy opposite sides. The mite lives entirely upon the food disgorged by the ant, which, strangely enough, seems to take pleasure in feeding its parasitic burden whenever called upon by the latter to do so.

The Effect of the Poison of Centipedes.[5]—From several experiments performed by Mr. Norman upon mice and snakes, it appears that the poison of centipedes is so virulent that, if it gets well into the circulation of such small animals as mice, they quickly succumb to its action. In the case of one experiment the mouse died within a few seconds after it was bitten; in another, the animal did not succumb until four days had elapsed. The two snakes experimented upon did not seem to be affected. They died, but this appeared to have been due to lack of proper care.

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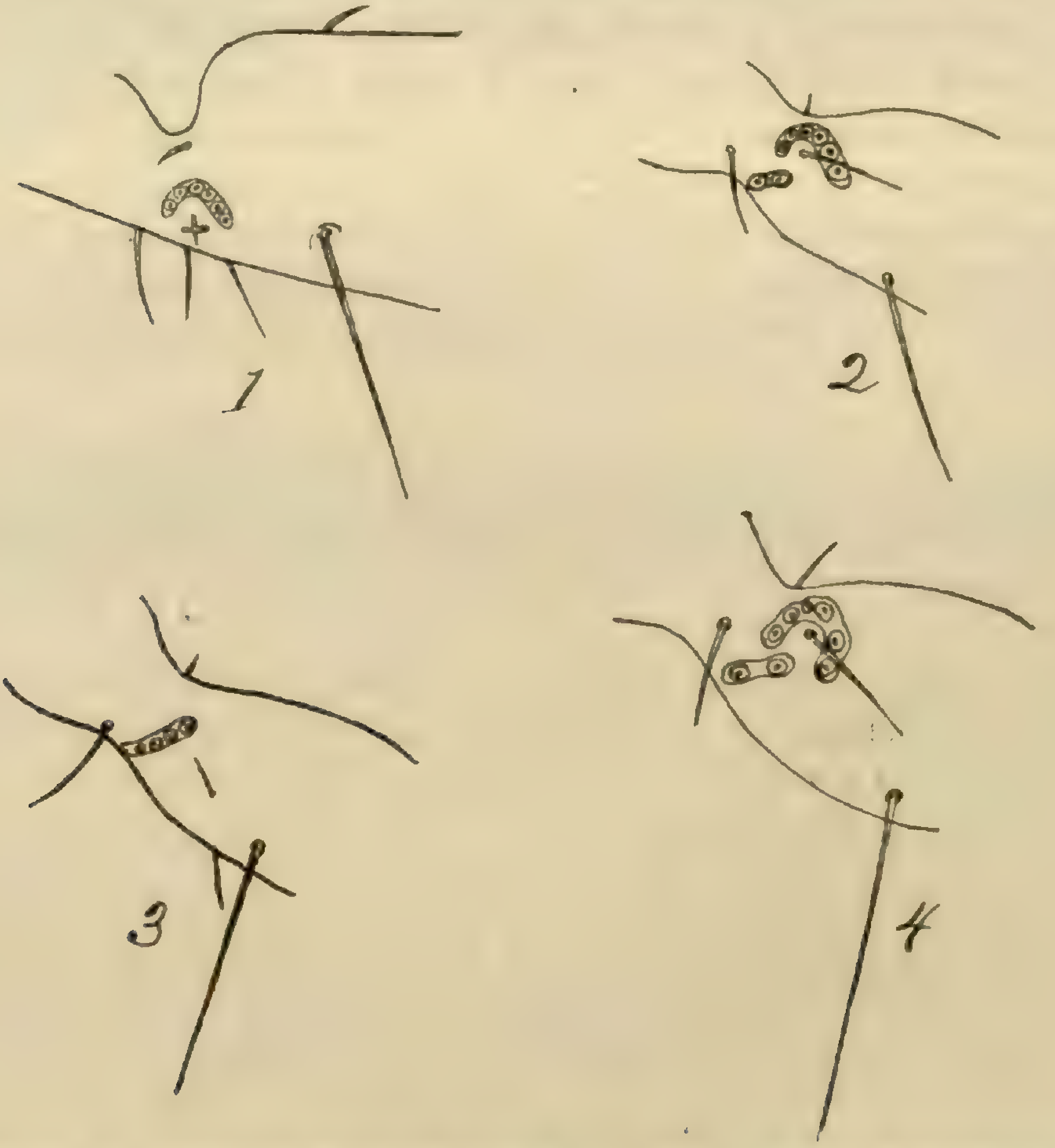
[4] Sur les rapports de *l' Antennophorus uhlmanni* Halber avec le *Lasius mixtus* Nyl. C. K. Acad. Sc. Paris, CXXIV, 583–5.

[5] W. W. Norman, Trans. Texas Acad. Sci., I (1896), 118–119.

The results of the experiments are so varying that it would be well worth the while of some one to undertake a series of experiments with the poison of centipedes that would result in more definite knowledge as to its effect upon the blood, tissues, etc., as well as to the rapidity of its action when injected into the circulation in different degrees of concentration.—F. C. KENYON.

An Organ on the Femur of Phlœothrips Resembling the Auditory Organ of Locusta.[6]—During his physopod studies Try-



Figs. 1–3. *Phlœothrips tibialis* Reuter ♀. Fig. 1. The base of the anterior, fig. 2. The base of the meddle, and fig. 3. The base of the posterior femur.
Fig. 4. *P. setinodis* Rent. Base of the posterior femur.

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[6] F. Trybom, Entom. Tidski, 17, 1896, No. 2–3, pp. 102–4, fig. 4.

bom found near the base of the femur in all three pairs of legs, in all of ten species of *Phlœothrips* studied, a peculiar area covered by a thin, transparent layer of chitin. Generally the areas are curved, but sometimes they are straight. In a specimen of *Phlœothrips tibialis* there was found on the left middle femur a straight area, and on the opposite femur a curved one. Through the thin chitin one may distinguish several dark bodies measuring from three and one half to four microns in diameter, which recall the round structures in the auditory organs of *Locusta* as described by Hensen. The organ is also found in *Thrips salicaria.*

" Delarvation " as a translation of the French " Echenillage."—When one considers the thousands of words to be found in that enormous list of English words, the Century Dictionary, and also the hosts of technical words constantly being proposed, one should hesitate before burdening the language further. But now and then one feels that it will be a conservation of energy to reduce a sentence or a phrase to a single word. How often is this the case in translating foreign words! The German "Anlage" is an example. Some authors have endeavored to introduce it bodily into English, and others to translate it by the old word "fundament," a term that to many a speaker of English recalls to mind something ludicrous. The French "échenillage" is another example.

The word is not uncommon in French literature relating to economic entomology, as the author learned a couple of years ago when collecting and translating literature relative to the gypsy moth. It means to remove larvæ from trees, bushes, fields or from wherever they may be, whether it be by hand picking, by treatment with an insecticide or any other method. There is but one word in English that can be used to express this, and that is the verb "to worm." But there are difficulties involved in its use that are very apparent. One can speak of worming one's cabbages or of sending some one to worm them, without involving any misunderstanding. But when one desires to speak of the process of worming cabbages, i. e., to use the verbal noun, one encounters trouble. First the verbal noun does not seem altogether euphoneous; second, one is, or rather the reader may be, puzzled to know which of the eleven meanings of the verb "to worm" given by the Century Dictonary is meant. He may ask, does it mean the action (1) of moving or squirming like a worm, or (2) of acting slowly and secretly, or (3) of affecting something slowly, or (4) of removing by underhand means, or

(5) of subjecting something to a stealthy process, or (6) of worming out some ones secrets, or (7) of freeing something from worms, or (8) of removing the charge from a gun, or (9) of removing the beard of any oyster or mussel, or (10) of giving something a spiral form, or (11) of winding rope-yarns, etc.?

Some other word seems necessary. One cannot use the term "larvate," for that is already in use, as a past participle in speaking of certain peculiarities of diseases that physicians meet with, and as an active verb in expressing the idea of masking.

The term "delarvate," the etymology of which is evident, is not to be found in the dictionaries and is here proposed as an English equivalent of the French échenillage. In his notes and manuscripts the author has used it constantly to avoid paraphrasing, and has gained time in so doing. Is the word not of sufficient value for general use? —F. C. KENYON.

ENTOMOLOGY.[1]

Dr. Smith's Study of the San Jose Scale.—At the 1896 session of the New Jersey Legislature, $1000 was appropriated to the State Experiment Station for the study of habits and enemies of the San José scale (*Aspidiotus perniciosus*) with a special view to the useful introduction of the latter into New Jersey. Dr. J. B. Smith was commissioned to make the investigations. In the Station report for 1896 Dr. Smith gives a full account of his studies and an admirable discussion of the subject. He visited California in May and found a great division of opinion regarding the usefulness of ladybird beetles as destroyers of this scale. But he found that "there is absolutely no disagreement concerning the beneficial effects of the *Vedalia cardinalis* (Fig. 1) as against the Cottony Cushion scale *Icerya purchasi.* There is no doubt that this insect, once so destructive, has been almost completely exterminated by the *Vedalia.* We do find that occasionally the scale reappears; but a colony of the beetles sent from the office of the local commissioner usually clears them out in a few weeks thereafter." But this is an exceptional and extraordinary case. The conditions regarding the San José species are different; there is little hope of a similar extermination by Coccinellids, and Professor Smith summarizes his results in these lines: "We have no good basis for believing that any of the insects introduced into New Jersey from California, or which can be introduced from that State, will become sufficiently abundant in a measurably short time to be of use in keeping the pernicious scale in check. The two species which have done the most effective work in California are already natives of New Jersey and require no introduction. Climatic differences make them less effective with us than they are on the Pacific Coast. We can probably count that both the *Aphelinus* and the *Chilocorus* will in time become increasingly abundant. Our most active species is *Similia* (*Pentilia*) *misella*, which thus far offers the best chance of an effective enemy. We cannot hope, however, that it will increase sufficiently to become an important aid for a considerable number of years to come, and it does not seem as if our fruit-growers could afford to wait for this or the other species to increase without taking active measures for the destruction of the scale.'

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[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

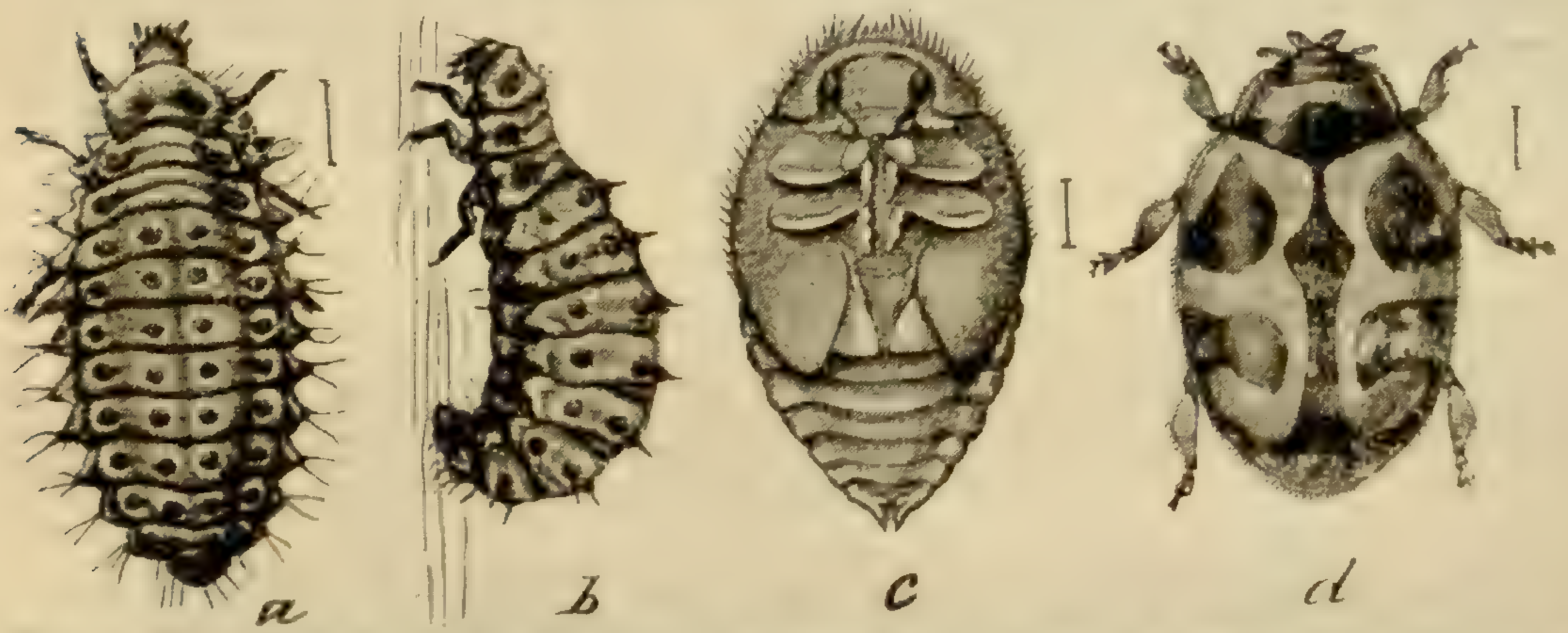

Fig. 1. The Vedalia Lady Beetle. *a*, larva, back view; *b*, larva, side view; *c*, pupa; *d*, beetle. Magnified. (From Insect Life).

CLARENCE M. WEED.

The Spruce Gall-louse.—Professor Chas. H. Fernald has published an excellent account of the Spruce Gall-louse, *Chermes abietis* Linn. The insect forms twig-galls on spruce, each gall containing from three to thirty or more cavities, each cavity inhabited by from ten to thirty small yellow lice. About midsummer the galls dry, and the young gall-lice crawl upon the leaves where they moult and become winged. These so far as observed are all parthenogenetic females which lay eggs and die, the dead bodies protecting the eggs. Two weeks later the eggs hatch into young, which crawl upon leaves and buds. Some of those on the buds survive until the following May to lay eggs for the summer brood which develop in the galls. No males were found during the two years study. Concerning the formation of the galls the author writes: "That this insect by its own operations is able to cause a young twig to develop into such an abnormal form is very interesting. Physiological botany teaches that all such growths as galls caused by insects, and callouses which grow over wounds inflicted on trees, are the result of what is known as stimulation. The stimulation or irritation in this case is the puncture of the setæ of the hibernating female into the bud, as previously described. Botanists agree that stimulation of this nature sets up a division of the plant cells. Each cell divides in the middle, producing two, which after reaching full size divide as did the parent cell, thus producing four. As this goes on, a swelling is naturally produced, and this swelling is the gall. It is not necessary that the insect should sting or poison the plant; the piercing of the setæ is sufficient cause for the formation of the gall. Essentially the same thing occurs when a limb of a tree is sawed off. The inner bark, the growing part of the tree, is injured or stimulated, and the cell division begins, causing a swelling or callous, which gradually grows over the end of the limb. Why the gall should take on its characteristic form and color has not been explained.

"As a result of the stimulation, there may be in addition to the cell divisions a deposition of material in the cells, as starch, proteids, resin, etc., which appear as minute granules of definite character. The plant cells of the gall produced by the insect are abnormally large, with thin walls, and contain more starch than those of the unaffected parts of the same stem. It may be that this starch is the food on which the young lice subsist."—C. M. W.

Hemiptera.—Mr. Elmer D. Ball finds[2] that all the forms of the genus Clastoptera hitherto described from North America with the possible exception of *C. brevis* (Walk.), may be referred to four species, viz., *C. delicata* Uhl., *C. proteus* Fitch, *C. xanthocephala* Germ., and *C. obtusa* Say. The species are well figured and described.

Willis Grant Johnson, A. M., has described[3] and figured five new species of scale insects belonging to the genera *Aspidiotus* and *Chionaspis*, with notes on their habits and parasites.

Dr. Philip R. Uhler has published[4] a summary of the collection of

[2] Proc. of the Iowa Acad. of Nat. Sci., 1895, III, 182–194.

[3] Bull. Ill. State Lab. of Nat. History, IV, 380–395.

[4] Proc. U. S. Nat. Museum, XIX, 255–297.

Hemiptera of Japan exhibited at the Chicago Exposition and afterward presented to the U. S. National Museum by Dr. K. Mitzukuri of the Imperial University of Tokio. Numerous new species are described.

In a lecture before the *Société Zoologique de France* M. Charles Janet quoted with approval Büsgen's views regarding the cornicles of Aphides. Büsgen believes that the cornicles are especially useful to the plant lice which do not excrete a sweet liquid, and which on this account are not protected from enemies by ants. The Aphides defend themselves against Ichneumon flies, Coccinellid larvæ, and Aphis lions (Chrysopa larvæ) by means of the cornicles which are movable and produce a secretion of a waxy nature which is smeared upon the head and antennæ of enemies.

Professor J. M. Stedman has discussed[5] at length the wooly aphis of the apple (*Schizoneura lanigera*). The subterranean form is said to do great damage to the apple in Missouri and is best kept in check by the application of tobocco dust around the base of the tree at a cost of but two cents per tree per year. In extreme cases the insects may be killed by the use of carbon bisulphide, but this method is not recommended, as a little carelessness may prove fatal to the tree, and it is also necessary to treat the trees with tobacco dust in order to keep the insects away.—W. F. FISKE.

Coleoptera.—Dr. John Hamilton records[6] observations on the habits of the blind beetle, *Pinadytes hamiltoni* Horn, from which "it is evident that the species is gregarious and carnivorous, apparently occurring oftener in the winter than in summer, and in woody, hilly, uncultivated places. Conjecturally, from its pallid color, absence of eyes, and conditions under which found, it seems in habit either subterranean or semi-subterranean, its presence under bark being that of a scavenger. The larvæ are probably wholly subterranean, subsisting on the dead larvæ and pupæ of the numerous insects which live beneath the ground during immaturity, and when discovered will probably prove to be eyeless."

Wm. G. Dietz, M. D., has monographed[7] the North American species of the tribe Ceutorhynchini of the family Curculionidæ. All the species are described and part of them figured. Many species and a few genera are new.

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[5] Bull. Missouri Agric. Exp. Sta. No. 35.

[6] Ent. News, VIII, 34.

[7] Transactions American Ent. Soc., Oct,-Dec., 1896.

Mr. A. L. Quaintance has made interesting notes[8] concerning the life history of *Brachytarsus alternatus*. He finds that instead of feeding on scale insects as had previously been supposed, the adults and larva feed on corn, beans and cow-peas.

Mr. C. W. Piper records[9] some interesting notes on the sembling habits of a certain ladybird (*Coccinella transverso-guttata*) in Washington. He finds that they are in the habit of collecting in large numbers on the summits of mountains with no apparent object. In one case this was so noticeable as to give the name ladybird mountain to a certain peak.

Dr. John Hamilton is unable to follow Captain Casey "in splitting Anthicus into ten genera with meaningless barbaric names; these so-called genera are simply groups convenient for the purpose of analysis and nearly all previously recognized by various authors. In a catalogue these groups may properly be noted by XXX, or, as in the European, designated by numerals."[10] Most entomologists will agree with Dr. Hamilton in his criticism; unnecessary divisions into genera are not to be encouraged.—C. M. W.

Diptera.—Mr. E. Porter Felt has contributed[11] to the knowledge of the structure of the antennæ of certain male diplosids. He confirms the observations of Kieffer[12] concerning certain novel structures which he describes as follows: "The arched filaments differ widely from ordinary setæ, though they occur in whorls in the same manner. They arise from pits in the chitine in much the same way as do the setæ, but, instead of remaining single and tapering to a point, they divide at their base into two equal branches which diverge to the middle of their length, where they recurve sharply as a rule and turn to unite with the base of the adjoining filaments in the whorl. Thus by means of the anastomosises these arched filaments, which from their designation one would expect to be free from each other, are in reality continuous, and form a looped thread around the segment with anchoring branches at regular intervals."

In a later article,[13] M. Janet has figured in detail the peculiar insertion of the arched filaments and presented a theory of their development. He suggests "that they may have arisen as hypodermic lamellæ, and that the edges may have become thickened and chitinized while the inner membranous portion gradually shrank from the outlining edges and disappeared. He holds the opinion that the chitinization of the thickened edges and the shrinking of the membrane at the apical portions of the lamellæ would in all probability begin before they had attained their full growth."

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[8] Ent. News, VIII, 1, 2.

[9] Ent. News, VIII, 49–51.

[10] Ent. News, VIII, 35.

[11] Psyche, VIII, 3–5.

[12] Bull. Seances, Soc. Ent. Fr., 1895, p. CXCII.

[13] Bull. Seances, Soc. Ent. Fr., 1896, pp. 37, 183–185.

Claude Morley, F. E. S., has described and figured[14] certain peculiar dipterous larvæ (*Metriocnemus fuscipes* Mg.) inhabiting rotten stumps. The figures and descriptions apply well to certain American species inhabiting similar localities.—W. F. F.

General Notes.—Under the title of Biological Notes on Certain Iowa Insects,[15] Messrs. H. Osborn and C. W. Mally describe the preliminary stages of the ground cherry seed moth (*Gelechia sp.*) with notes on a parasite, the early stages of the imbricated snout beetle (*Epicœrus imbricatus* Say); and give notes on the Cosmos weevil (*Baris confinis* Lec.), and on the early stages of a dipterous insect (*Chironomus sp.*) occurring in large numbers in water tanks and reservoirs.

The insects affecting the cotton plant have recently been discussed[16] by Dr. L. O. Howard. Especial mention is made of the cotton worm (*Aletia argillacea*) and several of its parasites; the boll worm (*Heliothis armiger*) and the cotton boll weevil (*Anthonomus grandis* Boh.), which are described and figured in all stages. Many other species are mentioned.

M. Charles Janet records[17] some interesting studies which show that the mite *Discopoma comata* is a true external parasite of the ant *Ladius mixtus*, attaching itself firmly to the body of the host and sucking the blood.

Mr. Wm. H. Ashmead has described[18] over forty new species of Cynipidous galls and gall wasps in the National Museum. One new genus is also described.

Miss Alice M. Beach catalogues[19] the Thrips of Iowa and describes five new species of Thrips proper, and one species doubtfully referred to Sericothrips. Professor Herbert Osborn in an accompanying paper describes a new species of Phlæothrips.

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[14] Entomologists Monthly Mag., VIII, 49, 50.

[15] Proc. Iowa Acad. Nat. Sci., 1895, Vol. III, 203–213.

[16] U. S Dept. of Agric., Bull. 33, Office of Experiment Station.

[17] Comptes Rendus, 1897, p. 102.

[18] Proc. U. S. Nat. Mus., XIX, 113–136.

[19] Proc. Iowa Acad. Nat. Sci., III, 214–227.

Mr. Samuel H. Scudder has prepared[20] a table for the determination of the genera of North American Melanopli, and gives notes on the distribution of species.

Part V of the Bibliography of American Entomology prepared by the U. S. Division of Entomology has recently been issued. It contains 1679 entries. We are glad to note that Dr. Howard expresses his intention to bring the work down to date, and to continue it hereafter. It is extremely serviceable to all working entomologists.

At a meeting of the Birmingham Entomological Society[21] Mr. W. Wilkinson exhibited a collection of insects made in the Madeira and Canary Islands in February, March and April, 1896. Among the most interesting species were *Pararge xiphia* from Madeira and *P. xiphiodes* from Grand Canary, two closely allied but distinct species peculiar to the Madeiras and Canaries respectively. Mr. Kenricks said that the most curious feature in the Canary Island fauna was the occurrence of American forms. *Vanessa huntera* occurs only in the Canaries and America, and *Anosia plexippus* (=*Danais archippus*) which is common in the Canaries is also an American species. Mr. Bethune Baker said that in working on the moths he noticed American affinities in several groups, especially in the genus Phlogophora, which wes much more closely allied to American than to European forms.

PSYCHOLOGY.[1]

Mr. Spencer's Psychology.—The following letter by Professor J. Mark Baldwin, President of the American Psychological Association, was read before the Philosophical Club of Bryn Mawr College, on the occasion of the celebration of the completion of Mr. Spencer's "Synthetic Philosophy."

Princeton, March 9.

To the Club:

In speaking briefly of Mr. Spencer's psychology, perhaps I can do no better than throw the impressions which I have into the form of informal pros and cons. I should premise what I have to say, however, with the remark that one of my reasons for not accepting your kind invitation to be present and speak on this occasion, was that I could not just now find time to put in exact form such a detailed appreciation as the proper attitude toward so great a subject requires. Yet I feel unwilling to allow the occasion to pass without bringing a trifle of some kind to add to your fuller tribute to Mr. Spencer. I beg, therefore, that you will consider what I say as impressions left on my mind from the study of Mr. Spencer's psychology—my personal reaction to his work—rather than as a well-formed opinion which I should in any way wish to commend to others.

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[20] Proc. Amer. Acad. Arts and Sci., XXXII, No. 9.

[21] Entomologist, XXX, 93, 94.

[1] Edited by H. C. Warren, Princeton University, Princeton, N. J.

First, then, for the pros.

1. Of course, the great and evident service rendered by Mr. Spencer in this department, as in others, has been his deliberate and argued advocacy of evolution. In all the spheres of the application of evolution doctrine, there was a prejudice to overcome; in none, such prejudice as here. It is not overcome yet. Spencer's is to-day, the name to refute, to pulverize, to anathematize, to ridicule, by the opposition which in Darwin's case spoke through the Bishop of Oxford, and which has used Spencer for its fulcrum ever since in raising the resistance with which science loads the other end of the lever. Fire a gun at the "First Principles," put to flight feelings and representative feelings, and re-representative feelings, and the cosmos is safe. In all this Spencer has borne the brunt. But all the while Herbart and Wundt and James—may the last-mentioned forgive me, but he more than others has ridden rough-shod over the pages of Spencer—have been getting the credit which they deserve for the coming of a naturalistic era in psychology.

In this matter of naturalism, our ship has had to change her course one hundred and eighty degrees; Spencer set the compass true in the new direction, and through all the buffetings, and breastings, and poundings, and creakings we are only just now getting her head to bear after his compass.

2. It is to me also a great thing that Mr. Spencer did not draw too sharp a line between biological and psychological evolution. All the talk about the boundary lines of science, the divisions of this *Gebiet* from that, this "point of view" here and that there—all this to the contrary, the objective science of mind is practically the great science after all. Of course, lots of qualifications are necessary here, and philosophers will demur, but I for one feel somewhat more secure when I have behind me the methods of objective science. Darwin's way of studying the emotions was more fruitful than that of his predecessors. Our knowledge of memory has been most advanced by research in

pathology and brain localization. Once discover pain-nerves, and we refute a theory academic from the year I. Now the credit of taking this objective point of view generally and of using so deliberately biological data and even biological explanations belongs to Spencer. What is the use trying to complete a psychology simply as such? What is the good trying with Wundt to abstract "pure feeling" from "pure sensation" when really both are pure mythology? Isn't it the defect of biology also that it tries too much to complete a biology merely as such, without the help of psychology? When two sciences are ripe enough to fall together and be one, that is good; but there is no earthly use in trying to keep them as far as possible apart in the meantime. In this, I think, Spencer was right. There is only one evolution, let us keep an eye on both sides of it.

3. As to Mr. Spencer's positive contributions to psychology, these I may not discuss in detail. They are mainly incidental to the ideas in the service of which his speculations were made. His theories have nearly all been disproved; I mean his particular theories. But his contributions by the way are of very great importance. And even the disproved theories, they have been leading-strings for thought and motives for research to countless workers. You cannot open a competent book in any of three or four great departments of thought, but you find the most fruitful discussions turning about the hypotheses of Spencer. I take it that this is one of the greatest possible services of a great man—to produce definitely directed effort, even though his private views go down in the result.

And now for the cons.

Here what there is to say seems to me to be mainly a statement of the limitations incident to the very qualities which we have found to be Mr. Spencer's principal claim to our admiration. Every great idea seems in its first blush simpler than it is. Natural selection, for example, is proving itself by giving ground. But the fame of its author, Darwin, does not suffer from that, even apart from the fact that Darwin was wiser than are his disciples. We are now saying "back to Darwin," and although we can never say "back to Spencer," yet Spencer has his place fixed for all that. The real limitations of Spencer are evident just in this contrast with Darwin.

1. Spencer's genetic Psychology was an idea, just as his genetic Biology and Sociology were ideas, and the same idea. But he could not prove this idea in all these departments. He could only see the evident and surface facts which his idea was likely to explain. This he did in a very remarkable way in the "System of Synthetic Philoso-

phy," the completion of which you are celebrating to-day. It is marvelous that a single mind should have been able to make so many happy hits in so rapid and, in a good sense, superficial survey of all these fields. But it was, I think, rather that he had a stupendously great idea than that he had a stupendously great mind. He was armed with the thought which all the natural sciences are tending to prove true; but the same sciences are showing that almost all the ways in which he took this idea to work were not true. This means that Mr. Spencer's personal tendencies were in the direction of his gifts, toward a deductive, hypothetical, inexact way of treating scientific details.

2. Then as to his method, that too is a great limitation. It has always seemed to me that Mr. Spencer was a great example of the costliness of analogy. Analogy, analogy everywhere! It is not a part of the interconnection of the sciences that the facts of one should be explained by analogies from another. Yet such a procedure Spencer constantly falls into. Chemical analogies in biology, biological analogies in psychology and sociology, mechanical analogies—dissolutions, integrations, etc., of force—all the way through. In psychology this is especially deplorable, since it leads to a general tendency—also apparent in the sociology—to be satisfied with inadequate analysis; and inasmuch as the analogies are drawn from spheres of simpler activities, it is just the refinements which characterize the higher as higher that escape it. Everybody knows the flat sterility which results when the association theory is applied to the higher reaches of thought and conduct. It is like proving a bed of tulips to be mere onions by going through them and nipping off all the blooms. So to solve the problems of psychology by biological or chemical analogies, is to make use of a weapon which figuratively speaking nips off all the blooms. But this is only part of another and deeper limitation, to wit:

3. Mr. Spencer's view of evolution is not what we are coming to-day to consider the true thought of natural genesis. Herein is the real and essential limitation of Spencer's work considered from a philosophical point of view—and possibly I am departing from the topic assigned me in mentioning it. He believes, I think, that the new not only comes out of the old, but that it is explained by the full statement of the old. Now this is a philosophy; and it is a leveling-down philosophy—whatever we say to the question as to where it finally lands us. It tends to state the tulip in terms of its roots. Now this is all right as science, but when it is made a philosophy and a presupposition to science, then it is baleful. For besides rendering it excessively difficult to be a good scientist—not to judge it as a philosophy—it makes the thinker liable

to continual "illusions of simplicity"—(thus to designate the fallacy of taking things to be too simple). So with Mr. Spencer's psychology: it impresses one as a series of great illusions of simplicity. Many of his generalizations depend each upon just one fact of striking and easy interpretation from his point of view. The "surplus energy theory" of play, the "dream theory" of spirit, the "dance theory," the "vocal theory." And many of the more important principles which are not of so easy an interpretation seem nevertheless to owe their place as corner stones in the system to this same tendency to simplification. Such are "utility," "use inheritance," etc.

4. The same thing is seen in the ease with which difficult places are glossed over. A bridge of analogy or often of mere vagueness of expression covers a yawning gap sometimes at a most critical place. This, however, is so common a criticism of Mr. Spencer, that I need not take it farther.

In conclusion I may say that the balance to the good in any fair estimate of Mr. Spencer's work is so enormous, that we should not hesitate to recognize as correct the verdict of all the world to the effect that he is one of the main factors in the main movement in the history of modern thought.—J. Mark Baldwin.

Involuntary Movements.—The manner in which ideas present in consciousness determine involuntary movements, especially of the hands, has already received considerable experimental attention from Lehmann, Féré and Jastrow. Their results have lately been supplemented in two important particulars by Mr. M. A. Tucker, of Stanford University.[2] The object of Mr. Tucker's investigation was to determine, first, any general tendencies to motion in the hand, apart from the spatial influence of thought; and second, the comparative value of these involuntary movements in adults and children. The apparatus used was similar in its essential features to Jastrow's automatograph. To prevent the attention taking on a directional character, in the experiments where this was to be avoided, the subject recited the multiplication table, conjugated French verbs, etc.

As regards the first point of investigation, there was found to be a "tendency for the hands and arms resting in front of the body to move inward toward the median plane of the body." There did not appear to be any necessary tendency for the hands to move toward a visible object to which the attention was directed, if that object was thought of simply as at rest; but the sight of moving objects, or the remembrance of them, caused an involuntary imitation of the direction of the moving stimuli, not only by the hands, but also by the whole body; this tendency manifested itself in a distinctly observable swaying of the head. As to the second point, the investigation brought out the general fact that "children are governed by and subject to the same laws as adults, but to a less extent." Individual variations were wider in them than in adults. No differences were found in children due to age or sex.

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[2] Amer. Jour. of Psychol., 1897, VIII, 394–404.

These experiments seem to substantiate the views of Féré and Lehmann, while they disagree with those of Jastrow, who reported a tendency of the hands to move toward stationary objects whenever the attention was directed towards their locality.

Contraction of the Field of Vision.—It has been questioned for sometime whether the contraction of the field of vision after repeated tests of the periphery (attributed to fatigue) is limited strictly to pathological cases. Of recent years it has been generally assumed that this phenomenon appears frequently in normal life as well, and in consequence it has lost much of its former value as a psychiatrical symptom. Dr. Erdmann Mueller, however, has recently published[3] the results of an investigation undertaken upon 102 normal subjects which show the contrary to be true. The tests were made without a perimeter, the object of vision being a small, white ivory ball of the size of a cherry-pit, which was fixed to a thin, translucent piece of fish-bone.

Out of the entire number of subjects tested, but two showed any unusual contraction of the visual field. In three separate trials apiece, with each eye, these two subjects showed a contraction varying from 10° to 30° in the course of a single trial, but each showed no contraction whatever in one of the tests. The subjects in question were found to be suffering from slight neurasthenia, but exhibited no severe neurotic symptoms whatever. Of the remaining 100 subjects, three showed a contraction of 5°, and thirty a contraction of from 2–4° only; but in seventeen of these cases a contraction of the field on one side was accompanied by a widening on the other, so that the apparent change may easily have been due to a slight shifting of the position of the head during the progress of the experiment. The other sixty-seven subjects showed a contraction of 1° or less, which was below the threshold of experimental precision.

As a result of these tests, Dr. Mueller concludes that the contraction occurs among healthy persons, if at all, only in the very slightest degree; where it is observed to any marked extent among the apparently healthy, it is shown to be accompanied by other neurotic symptoms. The test requires considerable attention on the part of the subject, and an apparent contraction of the field on the first trial often proves to be due to a lack of adjustment of the attention. The existence of genuine contraction can be affirmed only after repeated trials when the subject has become accustomed to the methods and has learned to maintain his attention properly.—H. C. W.

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[3] Arch. f. Psychiat. u. Nervenkr., 1896, XXIX, 225–230.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Zoological Society of London.—The sixty-eighth anniversary meeting of this Society was held at their offices, 3 Hanover Square, W. In the absence of the President, the Chair was taken by Dr. Edward Hamilton, Vice-President, who was supported by Lord Medway, Sir Hugh Low, General Trevor, Dr. Henry Woodward, F. R. S., Lt.-Col. H. H. Godwin-Austen, F. R. S., and many other Fellows of the Society.

After the Auditors Report had been read, and a vote of thanks accorded to them, and some other preliminary business had been transacted, the Report of the Council on the proceedings of the Society during the past year was read by Mr. P. L. Sclater, F. R. S., the Secretary. It stated that the number of Fellows on the 1st of January, 1897, was 3,098, showing a net increase of 71 members during the year 1896. The number of new Fellows that joined the Society in 1896 was 207, which was the largest number of elections that had taken place in any year since 1877.

The total receipts of the Society for 1896 had amounted to £27,081.10.4, which was £123.1.3 more than the very successful year 1895. The ordinary expenditure in 1896 had amounted to £23,788.1.2, which was an increase of £327.4.4 over that of the year 1895. Besides this a sum of £2617.15.0 had been paid and charged to extraordinary expenditure, of which amount £2600 had been paid on account of the construction of the new house for ostriches and cranes. A further sum of £1000 had also been transferred to the Deposit Account, leaving a balance of £1066.15.4 to be carried forward for the benefit of the present year. The usual scientific meetings had been held during the year 1896, and a large number of valuable communications had been received upon every branch of zoology. These had been published in the annual volume of "Proceedings," which contained 1110 pages, illustrated by 52 plates. Besides this Parts 1 and 2 of the 14th volume of the Society's quarto "Transactions" had been published in 1896. A new edition of the List of Animals, containing a list of all the specimens of the vertebrated animals that had been received by the Society during the past 12 years, had been published and issued to the subscribers to the publications in November last. The 32d volume of the Zoological Record (containing a summary of the work done by zoologists all over the world in 1895) edited by Dr. David Sharp, F. R. S., had been also published and issued to the subscribers in December last.

The Library, containing upwards of 20,000 volumes, had been maintained in good order throughout the year, and had been much resorted to by working naturalists. A large number of accessions, both by gift and purchase, had been incorporated.

The number of visitors to the Garden in 1896 was 665,004, being 322 less than the corresponding number in 1895. This slight decrease was easily accounted for by the unsettled state of the weather in the latter part of the past year.

The number of animals in the Society's Gardens on the 31st of December last was 2,473, of which 902 were Mammals, 1,132 Birds, and 439 Reptiles and Batrachians. Amongst the additions made during the past year 18 were specially commented upon as of remarkable interest, and in most cases new to the Society's collection. Amongst these were a young male Manatee from the Upper Amazons, a young male Klipspringer from N. E. Africa, a young female Gorilla from French Congoland, a pair of lettered Aracaris from Pára, a young Bragga's Monkey from French Congoland, a Loder's Gazelle from the Western Desert of Egypt, three Ivory Gulls from Spitzbergen, and three Franklin's Gulls from America. A serious loss was occasioned to the Society's menagerie by the sudden death in March last of the male Indian Elephant (Jung Pasha), deposited in the Gardens by H. R. H. The Prince of Wales, on his return from India in 1876, and for the past 20 years well known to all visitors to the Gardens.

A vote of thanks to the Council for their report was then moved by Dr. Henry Woodward, F. R. S., seconded by Lord Medway, and carried unanimously.

The report having been adopted the meeting proceeded to elect the new members of Council and the officers for the ensuing year. The usual ballot having been taken, it was announced that William Bateson, Esq., F. R. S., Col. John Biddulph, Dr. Albert Günther, F. R. S., Osbert Salvin, Esq., F. R. S., and Joseph Travers Smith, Esq., had been elected into the Council in the place of the retiring members; and that

Sir William H. Flower, K. C. B., F. R. S., had been re-elected President; Charles Drummond, Esq., Treasurer; and Philip Lulley Sclater, Mat., Ph. D., F. R. S., Secretary, to the Society for the ensuing year.

The meeting terminated with the usual vote of thanks to the Chairman, which was proposed by Sir Hugh Low, G. C. M. G., seconded by W. E. Lord Phillips, and carried unanimously.

Boston Society of Natural History.—The Annual Meeting was held Wednesday evening, May 5, 1897.

Business: Reports of the Curator, Librarian, Treasurer, and Trustees; announcement of the award of the Walker Prize for 1897; election of officers for 1897–98.

The following paper was read: Dr. R. T. Jackson, "Some Principles of Invertebrate Paleontology."

The following officers were elected: President, Charles Sedgwick Minot; Vice-Presidents, Nathaniel S. Shaler, Charles P. Bowditch, Edward S. Morse; Curator, Alpheus Hyatt; Secretary, Samuel Henshaw; Treasurer, Edward T. Bouvé; Librarian, Samuel Henshaw; Councillors for Three Years, S. L. Abbot, William S. Bryant, Miss Clara E. Cummings, William M. Davis, James H. Emerton, Edward G. Gardiner, Henry W. Haynes, Miss Catharine I. Ireland, Benjamin Joy Jefferies, Nathaniel T. Kidder, Edward L. Mark, William H. Niles, F. H. Peabody, Charles P. Putnam, Alfred P. Rockwell, William F. Whitney.

By the courtesy of the Massachusetts Institute of Technology the General Meeting was held, in Huntington Hall in the Rogers Building of the Institute, Wednesday Evening, May 19th, at 7¾ o'clock. Paper: Mr. James Edwin Lough; The Phenomena of Telepathy. Mr. William Eliot Davis exhibited his dog, "Dodgerfield" whose actions are supposed to be governed by telepathic influence.—SAMUEL HENSHAW, *Secretary.*

National Academy of Sciences.—The following officers were elected on the 21st: Prof. Asoph Hall, Vice-President; Prof. I. Remson, Home Secretary; Prof. A. Graham Bell, Treasurer.

The new members elected are: Dr. C. S. Minot, of Boston; Prof. Morley, of Cleveland; Prof. Gooch, of New Haven; and Dr. W. H. Dall, of Washington.

The next or November meeting will be held at Boston, beginning on Tuesday, November 16, 1897.

University of Pennsylvania Biological Club.—A meeting of the Biological Club was held at the Biological Hall, Monday, March 15, 7.45 P. M. Demonstrations: "Dæmonelix, a Fossil Plant of N. E. Nebraska," Mr. G. R. Wieland. Original Communications: "Summary of Lamarck's 'Philosophie Zoologique,'" Dr. P. P. Calvert; "Humming-Birds," Mr. H. Heath. Reviews: "Vertebrate Paleontology," Dr. E. D. Cope; "Botany," Dr. John W. Harshberger.—H. C. PORTER, *Secretary.*

Anthropological Society of Washington.—April 3, 1897.—The 262d Regular Meeting of the Society was held in the Assembly Hall of the Cosmos Club, on Tuesday, April 6. Program:—"One-Sided Bodies Produce One-Sided Brains," George M. King, M. D.; "The Zuni Harness-Batten, a Study in the Geographic Distribution of Weaving Apparatus," Prof. Otis T. Mason.

May 1, 1897.—The 264th Regular Meeting of the Society was held in the Assembly Hall of the Cosmos Club, on Tuesday, May 4, at 8 o'clock, P. M. Program:—"Progress and Achievements of Hygiene," Dr. George M. Kober; Discussion by Surg.-General George M. Sternberg, U. S. A.; General Discussion upon Sanitation among Primitive Peoples, George R. Stetson, Lester F. Ward, Wm. H. Dall, Otis T. Mason, Thomas Wilson, Cyrus Adler, J. Ormond Wilson, Weston Flint, and others.—WESTON FLINT, *Secretary.*

The Biological Society of Washington—The 278th regular meeting was held on Saturday evening, May 22d, 1897, at eight o'clock, in the Assembly Hall of the Cosmos Club, 1520 H street, northwest. Communications: Brief Informal Notes and Exhibition of Specimens. Erwin F. Smith, "A Bacterial Disease of Cruciferous Plants"; B. T. Galloway, "The Effects of Environment on Host and Parasite in Certain Diseases of Plants; V. K. Chestnut, The Poison of the Common Black Nightshade.—FREDERICK A. LUCAS, *Secretary.*

The Academy of Science of St. Louis.—At the meeting of the Academy of Science of St. Louis, on March 15, 1897, President Gray in the chair, present also thirty-five members and guests, a portrait of Enno Sander, who, for the last thirty-five years has served uninterruptedly as its Treasurer, was presented to the Academy. Dr. Hambach spoke entertainly and instructively on what a geologist may find of interest about St. Louis, exhibiting specimens of the principal fossils and minerals characteristic of the local deposits, and indicating the best localities for the collection of certain specimens. One person was admitted to active membership.

May 3, 1897.—Twenty-one persons present. Mr. H. Von Schrenk spoke of the respiration of plants, with special reference to the modification of those growing with their roots submerged in water. The lecture was illustrated by a demonstration of the liberation of carbon dioxide in respiration, from the roots of an ordinary flowering plant and freshly gathered fungi, and the more usual aerenchyma structures were made clear by the use of lantern slides.

Professor F. E. Nipher described a simple means of measuring the resistance of a tube to the flow of a current of air, when compared with an accepted standard, by the use of a tubular device similar in principle to the Wheatstone bridge used in electrical instruments, the apparatus, in the present instance, consisting of parallel tubes filled with air, connected by a tubular bridge, in the middle of which a drop of water was placed, so as to change position with the variations in the flow of air on the one hand or on the other.—WILLIAM TREALEASE, *Secretary.*

Society of Natural History of Delaware.—At the regular meeting of the Society, held Monday, February 1st, Edward Tatnall presented eleven volumes of botanical works,—these included "An Introduction to the Science of Botany," by the late James Lee, published in London in 1810; "Manual of Botany for North America," by Prof. Amos Eaton, published in 1833; "An Introduction to Systematic and Physiological Botany," by Thomas Nuttall, published in 1830. Miss Sarah M. Fell gave a collection of the ferns of New Castle County, Delaware.

Mr. Walter D. Bush, of the Ornithology Committee, reported having seen no black-birds as yet. They are usually here at an earlier date. He had not been able to find any blue-birds this winter.

Edward Tatnall reported having found hepatica, sanguinana and violets in bloom December 8th, and Symplocarpus in full bloom January 13th.

Mr. John T. Pennypacker gave an account of the researches of Prof. E. D. Cope among the debris in the rock-cleft at Port Kennedy.

Dr. Wm. C. Pierce read a valuable paper on "Night Lights of Insects."

The Fourth Triennial Congress of American Physicians and Surgeons.—The Fourth Triennial Congress of American Physicians and Surgeons was held in Washington, D. C., May 4th, 5th and 6th. The first general session was held on May 4th, at the Columbia Theatre, where the members were welcomed in an address by Dr. L. C. Gray, the Chairman of the Executive Committee. After the address the subject, "The Gouty and Rheumatic Diathesis, and their Relation to Diseases of the Eye," was discussed in papers by Doctors C. S. Bull, S. O. Richey, S. D. Risley, Robert Sattler, and R. A. Reeves. The subject was further discussed by Doctors J. M. DaCosta and H. M. Lyman.

The triennial banquet was held in the evening at the Arlington Hotel.

The second general meeting was held May 5th, in the New National Theatre, under the direction of the Association of American Physicians, the American Physiological Society and the American Pediatric Society. The subject for discussion was, "Internal Secretions Considered in their Physiological, Pathological and Clinical Aspects," on which Dr. W. H. Howell and Prof. R. H. Chittenden of the American Physiological Society, Dr. George Adams, Dr. J. J. Putnam and Dr. F. P. Kinnicutt of the Association of American Physicians, and Dr. W. Osler of the American Pediatric Society, read papers.

At 5 P. M. the members of the congress and their invited friends met in the auditorium of the Army Medical Museum (on account of the weather) with the American Surgical Association and the Alumni Association of the Jefferson Medical College for the unveiling of the bronze statue to Dr. Gross, physician, surgeon and teacher, standing in the grounds of the Smithsonian Institute. After a prayer by Rev. B. L. Whitman, President of the Columbian University, the statue was presented to the United States in an address by Prof. Claudius H. Maston. This was to have been followed by the unveiling of the statue by the granddaughter of Dr. Gross, Miss Adele Horwitz, but on occount of the inclemency of the weather already mentioned this portion of the ceremony was omitted. There followed then the address of acceptance by Brig.-Gen. G. M. Sternberg, M.D., as representative for the government. This was followed by an address, of which the character and the work of Dr. Gross was the subject, by Dr. William Keen. After the benediction the meeting adjourned for the evening meeting of the congress.

At 8.15 P. M. the evening session of the congress was begun in the Columbia Theatre, where the retiring President, Dr. William H. Welch, delivered an address on "Compensatory and Protective Pathological Processes."

At the first meeting Washington was chosen as the permanent place of meeting of the congress.

The affiliated societies were the American Otological Society, the American Neurological Association, the American Gynecological Society, the American Dermatological Association, the American Laryngological Association, the American Surgical Association, the American Clinatological Association, the Association of American Physicians, the American Association of Genito-Urinary Surgeons, the American Orthopedic Association, the American Physiological Society, the Association of American Anatomists, the American Pediatric Society, and the American Ophthalmological Society. At the meetings of these, held in various places, some three hundred and forty-one papers were read—obviously too many to be noted here.

New York Academy of Sciences.—Section of Geology.—May 17, 1897.—The first paper of the evening was by Mr. D. H. Newland, entitled "Occurrence and Origin of the Serpentines near New York." Mr. Newland spoke of the occurrence of the Serpentines in the vicinity of New York, and classified them according to origin into two probable divisions: one including those from New Rochelle and Hoboken, possibly derived from metamorphosed igneous rocks; and second, those from the other localities more probably derived from some form of sedimentary rock.

The second paper of the evening was by Professor J. F. Kemp, entitled "Notes on Butte, Montana, and its Ore Deposits." Professor Kemp described the geological position of the copper and silver bearing ore rocks of Butte, and illustrated his talk with a number of lantern slides made from photographs in the region last summer. He spoke particularly of the geological succession enhibited in the relationship of two forms of granite, an earlier basic and a later acitic, cut by later rhyolite flows.

The third paper was by Professor Kemp, entitled "Notes on the Geology of the Trail from Red Rock to and beyond Leesburg, Idaho." This paper brought forth the first account known of the geology of about 100 miles of the trail mentioned, where the rocks are very varied in character, but mostly early Cambrian quartzites, together with many igneous rocks, including Tertiary rhyolites. The ore producing region is found in the valleys where the gravels are washed in some places by hydraulic force, and some gold obtained therefrom.

The last paper of the evening was by Professor C. A. Doremus, and was illustrated by a series of specimens recently received from France from M. Moissan, representing certain of the metals and carbides formed by the electric furnace. Some of these were very interesting geologically, because af their peculiar properties; particularly the carbonates of aluminum, calcium and cerium, which latter, when treated with water, produces all the gaseous series from marsh gas to the heavier petroleum products. The specimens exhibited are for final deposit in the National Museum, at Washington, D. C.

This being the last meeting of the Geological Section before the summer vacation, adjournment was made till October.—RICHARD E. DODGE, *Secretary.*

SCIENTIFIC NEWS.

A bill before the Michigan legislature to change the name of the Michigan Mining School to the Michigan College of Mines became a law early in April, and the latter is now the proper name of the institution. The students and the people of the Upper Peninsula generally have accepted the new name gladly, considering it much more appropriate for the character of the work done in the institution.

Another bill which has been pending for some time regarding the charging of tuition has been passed, fixing the rate at $25.00 for residents of Michigan, and not less than $50.00 or more than $200.00 for those residing outside of Michigan. The exact rate has not yet been determined by the Board of Control of the College. The question is under consideration, and in all probability will be fixed at $150.00 for non-residents of Michigan. This amount of tuition fee will correspond with that charged by other first grade technical schools in America, such as Columbia College School of Mines, the Rensselaer Polytechnic Institute, the Stevens Institute of Technology, and the Massachusetts Institute of Technology.

When the school was working out its policy, trying to solve its educational problems, it was thought wisest to charge no tuition, but to collect as wide a constituency as possible in order that there might be all possible chance to make the methods as broad and thorough as could be done. It was also deemed hardly just to the students educated here to demand tuition until the institution was much better equipped for its work than the appropriations granted during the first decade of its existence permitted. Now that success has been attained in educating men for practical work, as is evidenced by the positions which its eighty-six graduates hold, a list of which is given in the last catalogue, the institution seems fully warranted in charging hereafter for its instruction.

The new law goes into effect immediately after August 19, 1897, and will therefore not apply to students entering previous to that time.

A prospectus will soon be issued by the College, giving the details of the regulations finally adopted by the Board of Control.—FRANCES H. SCOTT.

In addition to the excursions already proposed for the geologist members of the coming International Geological Congress the Committee of Organization finds itself in position to propose a visit to the glacier Tséïsky, which will have for its starting point the station Darg-Kokh of the railway Rostow-Wladikavkaz. The trip will occupy two days, Sept. 4th (16th)—Sept. 8th (18th), and will be made under the direction of K. Rossikow. The expense is estimated at 20 francs in addition to that of the principal excursion.

As has been stated before in the NATURALIST, arrangements have been made for excursions to the Urals, to Esthonia, to Finnland, to the Crimea, and to the Dnieper. As the number of participants in these excursions is necessarily limited, geologists who are expecting to take advantage of these opportunities for research are advised to communicate their wishes to the Committee on Organization at an early date.

On April 14th the Zoological Station at Naples celebrated the twenty-fifth anniversary of its foundation. The German government has recognized the value of the station by voting, in 1880, to contribute $7,500 a year to it, which sum was increased in 1890 to $10,000. For $500 a year anyone can secure a "table" in the laboratory with all the privileges and conveniences it affords. Germany and her universities have 10 tables, Italy 9, Austria and Russia 2 each, Holland, Belgium, Hungary, Switzerland, Roumania, Bulgaria, 1 each, while others are held by the Universities of Oxford, Cambridge, Columbia, the British Association, and Smithsonian Institution. The only state which ever gave up its table was Spain, which no longer felt able to pay for it.

Work will soon be in full progress on the erection of a portion of the new Museum of Archeology and Paleontology, for the University of Pennsylvania. The architecture will be simple and of Italian renaissance style. Salmon brick will be the main feature in the building, although there will be plenty of stone trimming. A botanical garden, covering ten acres, will be laid out around the museum. The site of the structure was ceded to the University by the city on condition that a museum of art and science, surrounded by a botanical garden, be erected on it. The portion to be erected immediately will cost not less than $500,000, while the cost of the whole building will foot up to $4,000,000.

Doctors Maxwell and Swan, of Monmouth (Ill.) College, propose to organize a summer school of biology in connection with the college. The trustees have approved the plans, and the school will probably be located on the Mississippi River not far from Monmouth. The term will consist of a six weeks' course, and the tuition will be $15.00. The college will furnish the necessary collecting apparatus, microscopes, laboratory necessaries, and boats for conveyance. The students will be directed by Drs. Maxwell and Swan.

Dr. Persifor Frazer has been appointed to represent the Academy of Natural Sciences, the American Philosophical Society, and the University of Pennsylvania at the International Congress of Geologists at St. Petersburg. He has been commissioned by the Academy to present the Hayden Memorial award, consisting of a bronze medal and the interest of the special endowment, to Prof. A. Karpinski, the Chief of the Geological Survey of Russia, in recognition of the value of his contributions to geological and paleontological science.

The American Philosophical Society held a meeting followed by a conversazione in honor of Sir Archibald Geikie, on the evening of May 7th, at which the eminent geologist gave a rapid resumé of the recent geological work in the Hebrides and Faroe Isles. Previous to the reading of the paper the Society was presented by a few of its members with a portrait of the late Professor E. D. Cope, painted by Mr. George W. Pettit of Philadelphia.

Mr. H. Wilde, president of the Manchester Scientific and Literary Society has given the Paris Academy of Sciences the sum of $27,000 to be used in giving an annual prize of $800, for a discovery or publication in physical science, the prize to be made international. Mr. Wilde states that this gift is made in return for the benefit which he has derived from French science.

In accordance with the will of the late Prof. E. D. Cope, his fossil collection is to be sold and the proceeds devoted to establishing a chair of paleontology in the Philadelphia Academy of Sciences, whose occupant must be approved by the National Academy, and whose duty shall be chiefly that of original research.

The Constantine Medal has been awarded by the Russian Geographical Society to Th. Tschernyschew, for his many years' work on the geography and geology of Russia.

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ON THE AFFINITIES OF TARSIUS: A CONTRIBUTION TO THE PHYLOGENY OF THE PRIMATES.

BY CHARLES EARLE.

In order to form a just estimate of the zoological rank of an animal in the system we must take into consideration its whole organization and development. Any system of classification which only considers one set of organs at the exclusion of the others will probably lead to false ideas as to the systematic position of the animal in question. In endeavoring to determine the relationship of *Tarsius* to the other members of the Primates, we are met at the outset with that great difficulty in morphological enquiry to decide between characters due to inheritance and those arising from convergence. The phenomenon of homoplasy is being recognized more and more by naturalists, and it is only by a complete knowledge of the palæogenetic history of a phylum that we can decide surely whether certain characters of the skeleton, common to it and to other phyla, are homogenetic or homoplastic in their origin.

Tarsius stands preëminently among Mammals as one of the most interesting of generalized types, for in this genus we have an animal whose assemblage of characters relates it on one hand to the Apes, and on the other surely to the Lemurs. The question arises, is the position tenable if I maintain that as *Tarsius* exhibits many fundamental structural peculiarities only found in the Apes and Lemurs, as a result the Anthropoids and Lemuroids may be considered genetically related. I may add that the palæontological evidence supports this conclusion.

I find on further study that Mivart's views concerning the relations of the Lemurs and Apes are most unsatisfactory. He considers that the question of genetic relationship in classification should take a subordinate place, and if two groups of animals exhibit characters in common, it makes little difference whether the characters be due to convergence or were inherited from a common ancestor which gave origin to the two aggregations in question. In short, to Mivart classification is merely a convenience, and may or may not denote genetic relationship. Applying these principles to the arrangement of the Primates, Mivart merely placed the Lemurs and Apes together because they exhibit some characters in common, and not that he considered these two suborders of the Primates closely related. Since Mivart's important paper on "Lepilemur and Cheirogaleus" was written in 1873, great strides have been made in arranging some of the Mammals based on the true scientific principle of community of descent. A good example of the determination of adaptive versus essential characters is the case of the Carnivora, where the important discoveries of vertebrate palæontology clearly demonstrate that the Bears and Dogs are related, but the Mustelines, instead of being connected with the Bears, are related to the Civets. Again, the Hyenas came off the same stem as the Mustelines, and are related also to the Viverrines and not to the Cats, as supposed by Flower.

Burmeister, the monographer of *Tarsius*, considered this animal to be a Lemur, but with characters relating it to the Apes and also to the Insectivora. Burmeister's views as to the relationship of *Tarsius* is shown in the following passage from his Memoir: "Aber *Tarsius* ist nicht mal ein Affe, er ist vielmehr nur ein Halbaffe, ein Mitglied jener Gruppe, innerhalb welcher die frugivore oder zugleich omnivore Nahrung der hochsten Säugethiere in die ausschliesslich animalische zunächst insektivore, uberspringt." That Burmeister fully appreciated the essentially lemurine characters of *Tarsius*, and which I should like to emphasize, do not occur in any other Mammalian group except in the Lemurs, is evident from his paper. Hubrecht, who has recently written an important paper on the placentation of *Tarsius* insists on the close relationship between this genus and the Apes. Because Hubrecht finds that the histological structure of the placenta and the stalk connecting it with the embryo in *Tarsius* is structurally like that of the Anthropoids, he proposes to overthrow our present system of classification of the Primates, dividing this group into two distinct orders, and placing *Tarsius*, also the fossil genus *Anaptomorphus*, among the Apes. I believe that Hubrecht, in his discussion of the systematic position of *Tarsius*, has not taken into consideration the whole organization of this genus, and furthermore I am of the opinion that any classification of the Mammalia depending solely on the structure of the placenta and its connections will prove to be unreliable.

I am aware that there are many difficulties in the way of claiming that Lemurs and Apes are genetically related, but if one eliminates some of the highly adaptive and specialized characters of the Lemurs, which appeared late in their evolution, then these two groups of Mammals approach each other very closely and on osteological characters alone, we are unable at present to surely separate the early Lemurs from the Apes. In other words, the extinct Lemurs possess certain characters which are now found widely separate in the two suborders of recent Primates.

In order to allow the reader to form an unbiased opinion of the affinities of *Tarsius*, I will briefly review Hubrecht's important contribution to the placentation of *Tarsius*, and follow him in his comparison of the placental connections of *Tarsius* with that of *Erinaceus*, a typical Insectivore, and also compare both with what is known of the placentation in the true Lemurs.

In the early as in the later stages of *Tarsius*, the yolk sac only takes up a small portion of the cavity of the blastocyst, and there is never present an omphaloide placentation as in *Erinaceus*. In this character of its development *Tarsius* strictly follows the plan of the Anthropoids.

A very important point in the early development of *Tarsius* is that the surface of the chorion never becomes entirely villous as in man. In *Cercocebus* the villosities of the chorion are limited to dorsal and ventral areas. The fact that *Tarsius* has omitted this diffuse stage of the placenta found in the true Anthropoids, clearly shows that this is a specialization in the development of this genus. Hubrecht remarks in referring to this completely villous stage of the chorion of the Anthropoids: "Ich halte den Zustand welcher beim Menschen und Anthropoiden sich erhalten hat, tur sehr primitive." Again, he says: "Somit neige Ich zu der Ansicht hin, dass in diesem ununterbrochenen Zottenpelz ein primitiver charakter erhalten, und dass die partielle Zottenbildung von Niederen Affen, wie der Fig. K giebt; eher als ein abgeleiterer Zustand zu betrachten sei."[1] The reference he gives to Fig. K is the condition found in *Cercocebus*, where the villous areas of the chorion are restricted to patches above and below the fœtus. In *Erinaceus* the amniotic cavity is formed by a splitting of the epiblast, so that the portion of this membrane below the amnion is the only part directly concerned in the growth of the embryo; accordingly Hubrecht designates this as the epiblast proper, whereas the remainder of the epiblast not used in the formation of the embryo he calls the trophoblast. Prof. Hubrecht considers the development of the amnion as occuring in *Erinaceus* the primitive one, whereas the more ordinary way by folds growing over the embryo and uniting, as a secondary process. *Tarsius* follows the more normal formation of the amnion by the folding off of the embryo.

In an early stage in the development of *Tarsius*, there occurs a thickening in the external epiblast or trophoblast, and on the opposite side from the embryonic area, this is the placental "anlage" or rudiment. It is important to notice that the first indication of the placenta is situated ventrally in relation to the embryo, as in the Apes it is dorsal. Again, the origin of the placenta in *Tarsius* has no connection whatever with the allantois, and the latter organ never becomes directly connected with the placenta as will be shown later. At the time

[1] Die Keimblase von Tarsius, Leipzig, 1896, pp. 171 and 172.

of the origin of the placental "anlage" in *Tarsius* the whole blastocyst is lined by the mesoblast and in the portion of the latter which connects the placental anlage with the posterior end of the embryo, originates a very important structure, highly characteristic of the Anthropoids; this is the bauchstiel or ventral stalk. Prof. Hubrecht explains the genesis of the bauchstiel very clearly, and shows that as the embryo becomes folded off from the yolk by the development of the amnion, that this mesoblastic strip is carried with the embryo until the latter is really suspended in the cavity of the blastocyst, its only attachment to the wall of the same is by means of the bauch- or haftstiel as he calls it. Vascularization of the ventral stalk soon takes place by blood-vessels arising in it, and thus embryo and placenta are brought into vascular connection. Another very important point shown by Hubrecht is that the portion of the bauchsteil next to the embryo is permeated by two tubes, the dorsal is a prolongation of the amnion and the lower is the rudiment of the allantois. The latter is one of the most important discoveries made by Hubrecht in connection with the development of *Tarsius*, as he demonstrates that in *Tarsius*, as in the Apes and Man, the allantois is rudimentary and does not hang freely in the coelomic cavity as in the rest of the Mammalia. Prof. Hubrecht shows that the allantois rudiment takes no share in the vascularization of the bauchstiel as the following quotation proves:·"Finden wir in dem Haftstiel eine verhältnissmässig langen Restbestand dieses Allantois rohres, welches aber, wie bereits auseinander gesetzt wurde, an der Vaskularisation des Haftstiels keinerlei antheil hat." Professor Hubrecht compares an early stage of *Erinaceus*, before the splitting of the mesoblast (see his paper, stage 2), with that of *Tarsius* (fig. 7), in order to prove that *Erinaceus* has a sort of bauchstiel, connecting the rear end of the embryo with the trophoblast. In this stage of *Erinaceus* the extent of the mesoblast is very limited, but in *Tarsius* the whole blastodermic vesicle is lined by mesoblast.

Turning now to the fœtal membranes of the Lemurs, we find there is apparently little in common between the placentation of these animals and *Tarsius*. In *Tarsius* the placenta is diskoidal-deciduate, whereas in the Lemurs it is diffuse and nearly the whole surface of the chorion is villous. It appears then that we are dealing with two types of placentation fundamentally different in structure and origin; however, the early development of the placenta in the Lemurs is totally unknown so far as I have been able to learn. Turner has described the placentation in the genus *Lemur*, and Alphonse Milne-Edwards in the Indrisine Lemurs. In all known forms of Lemurs the allantois is a huge sac enveloping the embryos, and often having numerous diverticulæ. Milne-Edwards calls attention particularly to one point, that the external layer of the allantois has no intimate connection with the chorion, and moreover it is not vascular. The question then arises, if the allantois takes no share in the formation of the placenta in the Lemurs, the latter organ probably originates from the chorion as in the Apes. This point is not yet proven, and it remains for further research to find out how the connection between fœtus and chorion is brought about in the Lemurs.

Dr. Charles Sedgwick Minot, to whom I am greatly indebted for an important letter on the question of the placentation of the Primates, in his great work on "Human Embryology," divides the placentation of the Mammalia into two types, in the first group the allantois is large and supplies the chorion with its blood-vessels; this is the condition occurring in the majority of the Mammalia, excepting some of the Primates. In the more highly differentiated Anthropoidea, the allantois takes no part in the formation of the placenta, and the blood-vessels arise in the chorion and bauchstiel *in situ*. Dr. Minot designates this type as chorionic placentation. I quote two passages from his letter which have an important bearing on the question of the relations of the placentation of the Apes to that of the Lemurs: "Unfortunately, nothing satisfactory is known of the early stages of Lemurs, which are the critical ones for placental homologies, but as far as our fragmentary knowledge goes, I fail to recognize any impossibility of regarding the placentas of Monkeys and of Lemurs as of one fundamental type." Again Dr. Minot says: "Whether a placenta is diffuse or not cannot decide as to its homologies, for the human placenta is diffuse to start with, yet has nothing in common with the Ungulates, *though it may be compared, apparently, directly with that of the Lemurs.*"

I am not, at present, in a position to discuss the whole organization of the Lemurs, and will merely refer to the brain and female reproductive organs. In regard to the structure of the brain in the Lemuroidea, it may be said that the genus *Lemur* has a lower type of encephalon than is found in the *Indrisinæ*. As compared with the *Insectivora*, the brain of the Lemurs is in a much higher stage of development, and approaches nearer that of the *Cebidæ* than any other group. In *Lemur* the frontal lobes of the cerebrum are narrow, and the olfactory lobes are plainly visible in front; however, in *Propithecus*, the frontal portion of the cerebrum is quite highly developed, being as broad as in the American Monkeys, and contains secondary convolutions not seen in the lower forms of Lemurs. Again it is to be noted that in the Lemurs as in the Apes, the sylvian fissure is largely developed and extends a good ways superiorly on the hemispheres, and this character is particularly noticeable in the *Indrisinæ*. The antero-temporal sulcus is also well-marked in the Lemur's brain, and resembles this fissure in the Anthropoids. The posterior lobes of the cerebrum remain in a primitive condition, and the cerebullum is exposed as in the lower Mammalia. Prof. Flower calls particular attention to the presence in the brain of the Lemurs of the calcarine fissure which is so characteristic of the higher Primates, and speaking in general of the sulci of the inner part of the cerebrum of the Lemur's brain, Prof. Flower remarks that they follow also those of the Anthropoidea. The general configuration of the frontal lobes in *Nyctipithecus* among American monkeys is like that of *Propithecus*, but in the former the surface of the hemispheres is smoother and lacks the smaller convolutions seen in the *Indrisinæ*. Again, in *Nyctipithecus* the olfactory lobes project considerably beyond the cerebrum. In conclusion it follows from the above that the brain of the Lemurs is much more primitive than that of the Apes, but may represent a stage in the evolution of the brain which leads to the higher differentiated encephalon of the Anthropoids.

(*To be continued.*)

BIOLOGICAL STUDIES IN MASSACHUSETTS.
NO. 2.

BY GEORGE C. WHIPPLE.

MICROSCOPICAL ORGANISMS.

The examination of nearly forty thousand samples of water in Massachusetts collected from water supplies differing in locality and character, and extending through all seasons for a long term of years serve to give us a good idea of the micro-organisms inhabiting the fresh waters of this region. But, in studying them it must be remembered that the examinations were made from a sanitary standpoint, and that from the manner in which the samples were collected they include only such forms as are found floating in the water: the littoral forms are not represented except as they have become detached and accidentally carried into circulation.

The following table gives the names of the genera thus far observed. They are arranged according to the usual system of classification, and each class is divided into groups, according to abundance and frequency of occurrence. The first group includes those genera which, in their season, are often found in large numbers; the second group includes those which are only occasionally found in large numbers; the third those which often occur in small numbers; the fourth those which are rarely observed. This division, while not wholly satisfactory, enables us to separate the important from the unimportant forms. As observations multiply, the list will doubtless be extended and many genera will be changed from one group to another. The names printed in heavy type indicate that the organisms so marked have been the cause of trouble in a water supply.

DIATOMACEÆ.

Commonly found in large numbers. **Asterionella,** Cyclotella, **Melosira,** Synedra, **Tabellaria.**

Occasionally found in large numbers. Diatoma, Fragilaria, Nitzschia, **Stephanodiscus.**

Commonly found in small numbers. Epithemia, Gomphonema, Navicula, Stauroneis.

Occasionally observed. Achnanthes, Amphiprora, Amphora, Bacillaria, Cocconeis, Cocconema, Cymbella, Diadesmis, Encyonema, Eunotia, Grammatophora, Himantidium, Isthmia, **Meridion,** Odontidium, Orthosira, Pinnularia, Pleurosigma, Schizonema, Striatella, Surirella, Tetracyclus.

CHLOROPHYCEÆ.

Commonly found in large numbers. Chlorococcus, Protococcus, **Scenedesmus.**

Occasionally found in large numbers. Cœlastrum, Cosmarium, **Palmella, Pandorina,** Polyedrium, Raphidium, Staurastrum, **Volvox.**

Commonly found in small numbers. Closterium, Conferva, Desmidium, Euastrum, Eudorina, Gonium, Micrasterias, Ophiocytium, Pediastrum, Sphaerozosma, Staurogenia, Tetraspora, Ulothrix, Xanthidium.

Occasionally observed. Arthrodesmus, Bambusina, Botryococcus, Characium, Chaetophora, Cladophora, Dactylococcus, Dictyosphaerium, Dimorphococcus, Draparnaldia, Gloeocystis, Hyalotheca, Mesocarpus, Nephrocytium, Penium, Selenastrum, Sorastrum, Spirogyra, Stigeoclonium, Tetmemorus, Zygnema.

CYANOPHYCEÆ.

Commonly found in large numbers. **Anabaena, Clathrocystis, Coelosphaerum, Microcystis.**

Occasionally found in large numbers. **Aphanizomenon,** Chroöcoccus, **Oscillaria.**

Commonly found in small numbers. Aphanocapsa.

Occasionally observed. Gloeocapsa, Lyngbya, Merismopedia, Microcoleus, **Nostoc,** Rivularia, Sirosiphon, Tetrapedia.

FUNGI.

Commonly found in large numbers. **Crenothrix.**

Occasionally found in large numbers. Cladothrix.

Commonly found in small numbers. **Beggiatoa,** Leptothrix, Moulds.

Occasionally observed. Achlya, Leptomitus, Saprolegnia, Sarcina, Spirillum.

RHIZOPODA.

Commonly found in small numbers. Actinophrys, Amoeba.

Occasionally observed. Arcella, Cyphodera, Difflugia, Euglypha.

INFUSORIA.

Commonly found in large numbers. **Cryptomonas, Dinobryon, Peridinium, Synura, Uroglena.**

Occasionally found in large numbers. Bursaria, Chloromonas, **Glenodinium, Mallomonas, Raphidomonas.**

Commonly found in small numbers. Anthophysa, Ceratium, Cercomonas, Codonella, Epistylis, Monas, Tintinnus, Trachelomonas, Vorticella.

Occasionally observed. Acineta, Chlamydomonas, Coleps, Colpidium, Euchelys, Euglena, Euplotes, Glaucoma, Halteria, Heteronema, Nassula, Paramaecium, Phacus, Pleuronema, Raphidodendron, Stentor, Syncrypta, Trichodina, Uvella, Zoothamnium.

ROTIFERA.

Commonly found in small numbers. Anuraea, Conochilus, Polyarthra, Rotifera, Synchaeta.

Occasionally observed. Asplanchna, Colurus, Eosphora, Floscularia, Lacinularia, Mastigocerca, Microcodon, Monocerca, Monostyla, Noteus, Sacculus, Triarthra.

CRUSTACEA.

Commonly found in small numbers. Bosmina, Cyclops, Daphnia.

Occasionally observed. Alona, Cypris, Diaptomus, Sida.

MISCELLANEOUS.

Occasionally observed. Acarina, Anguillula, Batrachospermum, Chaetonotus, Gordius, Hydra, Macrobrotus, Meyenia, Nais, Spongilla ; besides spores, ova, insect scales, pollen grains, vegetable fibres and tissue, yeast cells, starch grains, etc.

An examination of the following table, a numerical summary of the preceding list, brings out some interesting facts:—

It will be observed that 186 genera have been reported, 108 plants and 78 animals. Of these only 18 are commonly found in large numbers, 13 plants and 5 animals. Twenty-one more are occasionally found in large numbers, 16 plants and 5 animals. Forty-one genera are frequently seen in small numbers, while 106 genera, or more than one-half of all are seen occasionally, some of them but rarely. The most important classes are the Diatomaceæ, Chlorophyceæ, Cyanophyceæ and Infusoria, as shown by the large number of genera and by their greater abundance. Furthermore, these classes include all but one of the 23 troublesome genera that have been found in large numbers. Eleven genera may be said to be very troublesome, because of their wide distribution, the frequency of their occur-

TABLE NO. 1.

Classification.	Number of Genera.				
	Commonly found in large numbers.	Occasionally found in large numbers.	Commonly found in small numbers.	Occasionally observed.	Total.
Diatomaceæ	5	4	4	22	35
Chlorophyceæ	3	8	14	21	46
Cyanophyceæ	4	3	1	8	16
Fungi	1	1	3	5	10
Rhizopoda	0	0	2	4	6
Infusoria	5	5	9	20	39
Rotifera	0	0	5	12	17
Crustacea	0	0	3	4	7
Miscellaneous	0	0	0	10	10
Total	18	21	41	106	186

rence, and their unpleasant effects. They are Asterionella, Anabaena, Clathrocystis, Coelosphaerium, Aphanizomenon, Oscillaria, Dinobryon, Peridinum, Synura, Uroglena and Glenodinuim. This list seems like a short one when one considers the annoyance that the micro-organisms have caused in the various water supplies of the State.

The following tables, compiled from the examinations of the State Board of Health, serve to give one an idea of the distribution of the various classes of organisms in ground waters and surface waters. In most cases the numbers given are the averages of monthly examinations extending over one or more years. They were selected with a view to showing the greatest range in the number of organisms in the classes of water tabulated, and they illustrate in a striking manner the comparative absence of organisms (except Fungi) in springs, wells and filter galleries: the presence of a variety of organisms in small numbers in rivers, and the abundance of microscopic life in the more quiet waters of ponds and artificial reservoirs. It is only in waters of the latter class that the microscopical organisms occasion much trouble by their excessive growth, and hereafter they alone will receive our consideration.

TABLE No. 2.

MICROSCOPICAL ORGANISMS IN GROUND WATERS.

(NUMBER PER C. C.)

No.	Locality.	Time.	Diatomaceæ.	Chlorophyceæ.	Cyanophyceæ.	Fungi.	Rhizopoda.	Infusoria.	Rotifera	Total Organisms.	Zoogloea (Units).
	SPRING WATERS.										
I	Spring in Westport	Apr. 21, 1894	455	0	3	0	0	0	1	459	0
II	Aqua Rex Spring, Millis	Aug. 27, 1894	1	180	0	0	0	0	0	181	0
III	Craig Spring, West Springfield	May 16, 1893	21	0	0	0	0	0	0	21	16
IV	Spring in Ipswich	July 27, 1892	12	0	0	0	0	0	0	12	0
V	Spring in Pepperell	Nov. 26, 1894	1	1	0	2	0	0	0	4	0
VI	Massasoit Spring, West Springfield	May 16, 1893	2	0	0	0	0	0	0	2	0
VII	Spring in Ware	July 17, 1893	0	0	0	0	0	1	0	1	0
VIII	Spring in Medfield	Aug. 31, 1894	0	0	0	0	0	0	0	0	0
IX	Spring in Pittsfield	Aug. 27, 1894	0	0	0	0	0	0	0	0	0
X	Cold Spring, Plymouth	July–Dec., 1894	0	0	0	0	0	0	0	0	0
	WELL WATERS.										
I	Tubular Well, Provincetown	1894	0	0	0	3130	0	0	0	3130	50
II	Tubular Wells, Revere	1894	1	0	0	281	0	0	0	282	—
III	Large Collecting Well, Marblehead	1894	0	0	0	173	0	0	0	173	8
IV	Tubular Wells, Hyde Park	1893–4	2	0	0	68	0	pr.	0	70	18
V	Tubular Wells, Malden	1891–3	5	0	1	1	pr.	1	0	8	7
VI	Tubular Wells, Lowell	1893	0	2	0	0	0	0	0	2	—
VII	Tubular Wells, Melrose	1894	0	0	0	1	0	0	0	1	—
VIII	Tubular Wells, Bradford	1893	0	0	0	1	0	pr.	0	1	547
IX	Well, Needham	1894	0	0	0	0	0	0	0	0	0
X	Well at Fitzwilliam, N. H.	1893	0	0	0	0	0	0	0	0	0
	FILTER GALLERIES.										
I	Filter Gallery at Reading	1891–4	3	0	0	3506	0	2	0	3511	726
II	Filter Gallery at Wayland	1891	15	4	1	1706	0	3	0	1729	71
III	Filter Gallery at Whitman	1891	1	0	0	137	0	0	0	138	41
IV	Filter Gallery at Watertown	1892	pr.	0	0	217	0	0	0	217	72
V	Filter Gallery at Framingham	1891	1	0	0	137	0	0	0	138	41
VI	Filter Gallery at Braintree	1894	0	0	0	34	0	2	0	36	94
VII	Filter Gallery at Woburn	1891	2	0	0	0	0	0	0	2	1
VIII	Filter Basin at Taunton	1891–4	86	2	4	24	0	48	1	165	14
IX	Filter Basin at Newton	1892–4	2	1	0	15	0	pr.	0	18	13
X	Filter Basin at Waltham	1892	17	0	0	0	0	pr.	0	17	4

TABLE NO. 3.

MICROSCOPICAL ORGANISMS IN SURFACE WATERS.

(NUMBER PER C. C.)

No.	Locality.	Time.	Diatomaceæ.	Chlorophyceæ.	Cyanophyceæ.	Fungi.	Rhizopoda.	Infusoria.	Rotifera	Total Organisms.	Zoogloea (Units).
	RIVERS.										
I	Stony Brook, Influent to Basin 3	1891-2	77	23	43	38	1	9	0	191	97
II	Mill River at Taunton	July-Sept. 1893	3	25	1	165	1	4	pr.	199	676
III	Merrimac River at Lawrence	1891-4	66	21	2	13	pr.	4	pr.	106	156
IV	Ipswich River	1892	12	1	0	87	0	5	0	105	31
V	Blackstone River at Uxbridge	1892	17	6	0	3	0	74	pr.	100	364
VI	Sudbury River, Influent to Basin 2	1891-2	45	16	2	32	pr.	3	pr.	98	128
VII	Cold Spring Brook, Influent to Basin 4	1891	54	pr	0	12	0	1	0	77	39
VIII	Nashua River, North Branch	1893	13	4	2	42	0	6	0	67	810
IX	Taunton River	1891-3	17	1	2	13	0	2	0	35	58
X	Lynde Brook, Worcester	1891	17	4	3	2	0	1	0	27	68
	NATURAL PONDS.										
I	Mystic Lake	1891-4	1917	199	pr.	18	pr.	172	pr.	2306	128
II	Jamaica Pond	Jan.-Aug. 1891	1110	103	137	1	1	12	1	1365	174
III	Horn Pond, Woburn	1891-4	911	302	218	1	1	167	2	1602	65
IV	Fresh Pond, Cambridge	1891-4	967	95	83	9	1	4	pr.	1159	127
V	Wenham Lake, Salem	1891-4	897	38	32	0	pr.	32	pr.	999	52
VI	Buckmaster Pond, Norwood	1891-4	184	83	9	2	1	665	pr.	944	30
VII	Lake Cochituate	1891-4	579	33	58	6	2	15	pr.	693	66
VIII	Spot Pond, Malden	1891-4	171	85	19	1	1	19	pr.	296	93
IX	Lake Williams, Marlboro	1891	170	17	66	1	0	14	0	268	67
X	Gates Pond, Hudson	1891-4	110	37	27	1	1	66	pr.	242	38
	ARTIFICIAL RESERVOIRS.										
I	Haynes Reservoir, Leominster	1891	3193	0	0	1	0	19	1	3214	155
II	Walden Pond, Lynn	1891-4	254	238	604	8	pr.	397	1	1502	64
III	North Reservoir, Winchester	1891-4	1337	35	72	1	1	149	pr.	1596	71
IV	Ludlow Reservoir, Springfield	1891-4	504	260	96	5	1	96	2	964	103
V	Scott Reservoir, Fitchburg	1892	691	146	10	2	4	92	2	947	42
VI	Holden Reservoir, Worcester	1891-4	646	24	6	1	pr.	29	1	707	76
VII	Basin 3, Boston	1891-4	270	55	23	1	1	12	pr.	362	122
VIII	Basin 2, Boston	1891-4	99	32	47	5	pr.	4	pr.	187	125
IX	Basin 4, Boston	1891-4	80	31	3	1	0	5	0	120	43
X	Basin 6, Boston	1894	55	5	0	0	1	31	2	94	20

NATURAL IMPULSES.

BY W. BERNHARDT.

There is a mystery existing in nature, inaccessible to human reasoning, as scarcely another one, although the phenomena connected with it are among the best known to us and of daily occurrence. When comparing a grain of mustard seed and one of poppy seed we even with the help of a magnifying glass cannot detect anatomical differences of any concern. Each of them encloses two cotyledons, i. e., the first leaves developing in germination; moreover, it contains a radicle and the beginning of a stem, both located between the cotyledons. Structure and appearance of these primitive organs are very similar in both seeds, and yet what a difference between a grown mustard and a poppy plant! Not only flower and fruit but the whole plant assumes a particular shape and character differing externally as well, as in chemical constituents. We are forced to believe, that the cells, from which both plants originate, are endowed with a disposition forcing the growing organs to assume certain forms in accordance with a certain exchange of matter.

Such a disposition or plan of structure is inherent to every germ of plant and animal. Not the strongest microscope, nor any other means of observation have enabled us to ascertain the matter and processes upon which variation of development depends; only this much has been established, that the faculty is particular to the germ itself, the forms resulting from the growth of a certain kind of germ invariably manifesting the same characters, independent from external influences. Soil, climate and light certainly modify the thriving of a plant, and, when unfavorable, can even prohibit growth, but the plant resulting nevertheless invariably shows the characters of the species to which it belongs. Neither in animal nor in plant, has domestication or horticulture ever generated a new species.

The author by these remarks does not intend to dispute the possibility and even probability, that new species have sprung from former ones in the course of unmeasurable past times; on the contrary, there are numerous geological, botanical and zoological facts known, which irresistibly point in that direction, but in historic time, i. e., during the last 5000 years, no evident change is known to have happened. Plants, animals and people represented on old Egyptian and Assyrian sculptures are exactly the same as those existing nowadays. The time, when linking forms between lizards and birds, as the pterodactylus, were living, lies in a remote past, and the origin of existing transient forms, as ornithorhynchus, lepidosiren and amphioxus may without scruples be dated back to periods preceding the appearance of man. Perfectly agreeing to the view adopted by most naturalists of our time, that plants as well as animals are the results of gradual evolution originating from monocellular organisms, we find it supported by the convincing argument of the descent of every single being from a minute fertilized cell, the embryo of man itself in its first stages closely resembling those of other animals, differences in the accomplishment of organs appearing in the advanced periods of growth.

By the comparison of any forms of higher animals including insects, evidence is given of a principle or type of symmetric structure common to all of them. There is a head provided with partly bilateral organs for the reception of objects and impressions from the outside and ending in a chord of nervous substance, the spine, located on the back or front side of the body, and dividing it into two longitudinal halves, to which the organs of movement are attached equally distributed on both sides, one side being the reverse of the other one. Similar pervading principles of structure are found in lower animals, more or less varying according to the classes and families to which the beings belong. The structural principles pervading the vegetable world are different, but not less evident and striking ones. One of the chief features in higher plants is the constant repetition of the same number, or a multiple of it in the parts of the flower and the fruit. In many families the number 5 is the predominating one, in others 6, or another amount in the parts of the calyx as well, as in the petala, stamina, stigmata and carpella. Perfect symmetry in the arrangement and division of organs also is frequently found in plants and beautifully exhibited in many forms of ferns.

Pursuing the enforcing faculty, the impulse or will in animals or plants to conduct the formation of organs in certain unvariable ways, independent from external influences, we find it concealed in the minute embryo from which all creatures originate. But we have to admit at the same time, that the researches hitherto performed on this subject were but little successful, inasmuch as our knowleege in this respect is not much beyond that of our predecessors a century ago. They knew as well as we, that it is the germ or embryo, which is endowed with this power. The only apparent progress made is a hypothetical one, and consists in the prevailing opinion that in germination and growing, two different kinds of cells are active, some of them, the vegetative cells, being chiefly engaged in nutrition and growth, the others, or reproducing cells, for transferring to young individuals and preserving the character of the parents, family, tribe, etc. It is upon the presence of this last kind of cells—most frequent in reproductive organs—that the resemblance in members of families and nations and of genera and classes is believed to depend. Scientists attribute the reproductive faculty to the nucleus of protoplasma or albuminous matter found in these cells.

The growth of cells is a limited one. When a certain store of food has been taken up and a certain amount of protoplasma has been formed, the latter, forming the kernel or nucleus of the cell, receives a gradually increasing stricture, dividing it into two halves, which finally separate; the stricture extends to the whole cell, which by division gives rise to two new cells perfectly resembling the mother cell as to form, organization and general characters. In this way multiplication of all reproducing cells takes place, including that of micro-organisms; it is the simplest and primitive way of generation of new individuals. We see, that the progress of our knowledge in this question is limited to the fact, that while formerly the embryo as a whole was regarded as the agent at once reproducing and preserving the original form, these functions nowadays are attributed to a certain class of its constituting cells, or rather to the protoplasma which they contain.

But a scanty comfort it is, that this theory affords to our mind eager to penetrate into this apparently unfathomable secret of nature, intimately connected with the question for the origin of life itself; but notwithstanding its deficiencies, the hypothesis of reproducing cells well explains the resemblance commonly existing between members of one family, its increasing in nearly related individuals and its diminishing by the interference of strange elements.

If permitted to consider the "cell" as the elementary organ in animals and vegetables, we are as well justified to attribute the same roll in the mineral world to the "crystal." There is no mineral substance existing which is not known to crystallize under certain circumstances, and the formation of cells in plants from the constituents of their juices, the secretion of muscular fibre from albuminous matter in blood, stands in closer relation to the separation of crystals from solutions, than is generally imagined. Who, when on a cold winter morning, finding the panes of his windows covered with ice-crystals shaped like luxurious ferns, mosses or twigs of pine trees, was not impressed with the conjecture of a relation between the phenomena of organization and crystallization of some common occult force giving form to organic as well as to nonorganic matter? Indeed, there are no strict limits existing between organization and crystallization. The curved line and surface may be regarded as particular to and characteristic of organic matter, the straight line and surface of mineral substances, but there are innumerable exceptions exhibiting the former in well defined crystals, while crystals of minerals frequently occur having curved surfaces. Thus the crystals of pyromorphite, chiefly consisting of phosphate of lead, are polyhedra with curved planes, and compounds of hydroxylamine with certain oxides of metals have hemispheric forms. The starch grain may be considered as the connecting link between both morphological classes, the round form on the one hand indicating a cell like character, its growing by attachment of layers on its outside on the other hand, perfectly agreeing with the way in which crystals are observed to grow.

It is in three states that solid matter is known to occur, in the amorphous, the crystalline and the organized states. The amorphous seems to be the original one, since the others are generally found to originate from it, the reverse but exceptionally taking place. The best known amorphous substance is glass, in which in its perfect state no crystalline particles can be discovered. Resins, such as colophony and copal, and Indian rubber are amorphous, as well as glue and molten sugar in its fresh state. In sugar the liability to pass into the crystalline state is very prominent; sometimes a few minutes after its cooling the transparent mass becomes opaque by the separation of minute crystals of sugar. Crystallization frequently sets in in some varieties of glass, particularly when rapidly cooled. Albumen is the principal amorphous substance in living animals from which organized matter is derived.

A striking difference of amorphous and crystalline matter is manifested in the behavior of their solutions. Amorphous matter soluble in water, when dissolved gives viscid or gelatinous liquids, their thickness increasing with the lessening amount of water present. No compounds with water in definite proportions seem to be existing. Solutions of crystalline matter, on the contrary, are thin as water; when concentrated to a certain point crystals of solid matter begin to separate. Crystallization sometimes sets in suddenly, the whole liquid turning into a magma of small solid particles suspended in the fluid. The solution contains compounds with water in definite proportions. When evaporating a solution of red cobalt chloride, it suddenly turns blue, which happens in the moment when more water has been removed, than the red salt needs for its existence.

Having tried to explain the resemblance in the features of related organisms by the prevailing of particular cells reproducing by unknown impulses the same character in every new individual, we feel induced to look for the cause of the well known fact, that mineral matter is subject to similar constraints, being forced, when crystallizing, to assume certain invariable forms. Every crystalline body has its peculiar shape varying only by the addition of planes belonging to forms of the same system. Compounds of different ingredients, but of similar constitution, are frequently found to appear in the same forms, as is seen in the class of compounds comprised by the name of "alum." Whenever a body is found crystallizing in several systems, a chemical difference, although perhaps a slight one, may generally be assumed. But in identical bodies polymerisation, or multiplication of atoms in a molecule, is a frequent cause of variations in form. It is one of the merits of the new doctrine of stereo-chemistry to have given the hint, that molecules of compounds as well as of elementary bodies, contain their atoms arranged in certain directions given by the prevailing chemical attractions. In accordance with this view every molecule may be represented by a certain stereometric form, be it a tetrahedron, an octahedron, a cube, etc. The attractions diverting accumulation of atoms in a molecule also govern the attractions uniting the molecules to visible crystalline individuals. The effects of such attractions are even frequently extended to the position of the crystals to each other. Every snow flake represents a system of symmetrically arranged numerous hexagonal ice crystals, the hexagonal form not only dominating in the single crystals, but being evidently noticeable in the whole beautiful arrangement. Common salt, when crystallizing from saturated solutions, is seen to separate in amphitheatrical square combinations consisting of single cubical salt particles. In the single crystals, as well as in their congregations, we observed the square predominating as the elementary form.

Neither in the manifold features of animal and plant life, nor in the crystalline formations of mineral matter, are external influences deciding as to the forms to be adopted. Individuals of different natural character of different species, grow up and become differently shaped, although exposed to the same external conditions. A slight transforming influence of temperature, light, food and contact cannot be denied, but the preservation of existing types of species and genera in all three natural worlds is the effect of unknown forces independently acting in reproductive cells and organs, as well as in mineral atoms and molecules. If we may expect ever to notice the formation of a new species under our eyes, this event will not depend upon external conditions, but upon a change in the nature of protoplasma, or of the chemical structure of a mineral molecule. The author does not doubt that such changes are continually going on in nature, but they are too slow and subtile to be accessible to our observation. The chief part in such changes will always be due to agents or forces peculiar to the elementary organs and exerting impulses, by which permanent forms are resulting.

CONTRIBUTIONS TO COCCIDOLOGY.—II.

By T. D. A. Cockerell, Mesilla, New Mexico.

No. I appeared in American Naturalist, Aug., 1895, pp. 725–732.

(1). *Icerya rileyi* Ckll. In September, 1893, I bred a *Lætilia* from a larva living on *I. rileyi* on mesquite at Las Cruces, N. M. The Rev. G. D. Hulst informed me that it was "different from *coccidivora* and from *L. ephestiella*, a good variety at least." It may, therefore, be as well to put its characters on record:—

Lætilia coccidivora var. *hulstii*, n. var.—Palpi ascending; fore wings gray, brownish at extreme base and beyond the first band. The first band, at end of basal third, double, consisting of a gray line bordered without by a white band. A wavy band consisting of two blackish lines not far from the exterior margin. Hind wings shining white; abdomen above whitish, banded with gray. It would seem to connect *coccidivora* with *ephestiella*, and so, perhaps, all are varieties of one.

(2). *Rhizococcus* (?) *devoniensis* Green, Ent. Record, 1896, p. 260. I should certainly prefer to call this *Eriococcus devonien-*

sis. We know already several species of *Eriococcus* with 7-jointed antennæ; the subgeneric name *Thekes* Crawford ms., is available for them.

(3). *Phenacoccus comari* (Kunow). *Coccus comari* Kunow, Ent. Nachr., 1880. Near Königsberg. See also Douglas, Ent. Mo. Mag., xvii, p. 90. The description appears to indicate a *Phenacoccus*, but it is very short.

(4). *Dactylopius edgeworthiæ*, n. sp.—♀ about or hardly 2 mm. long, pale gray, with light brown legs and antennæ. Form oval, back so thickly dusted with white meal as to appear white with a grayish tint; no distinct lateral or caudal appendages; extremely short, hardly noticeable thick caudal tufts. The white secretion on the back forms three more or less distinct longitudinal rows of small protuberances, giving the insect an obscurely tricarinate appearance. Immature ♀ similar, but not so mealy.

♀ boiled in KHO turns very dark lake-red, but does not stain the liquid. Antennæ 7-jointed, formula 7 (32) (41) 65. 3 is perhaps a *little* longer than 2; 7 is considerably longer than 5+6; 5 is very little shorter than 6; 4 is conspicuously shorter than 2 or 3. Legs ordinary, femur quite stout, its upper edge convex; tibia a little shorter than femur, stout; tarsus a little shorter than tibia. Claw moderate, with a minute denticle on its inner side. Digitules of claw slender, somewhat curved, extending a little beyond tip of claw, with fairly distinct knobs; no tarsal digitules. Anal ring with the usual six bristles. Caudal tubercles very low, ordinary, each with a large bristle, some short ones, round glands and a pair of conical spines. The insect throughout is very little hairy. The skin exhibits numerous gland-dots.

♂ sac ordinary; a ♂ with wings expanded taken from a sac. Length of body about 1⅔ mm.; head to tip of wing about 2 mm. Wings white, the nervures very distinct, costa not at all darkened. Antennæ pale ochreous, head pale olivaceous, prothorax dark slate gray, mesothorax pale ochreous, strongly contrasting. Abdomen dark olivaceous, legs white, with a yellow tinge. The pale ochreous color of the middle of the thorax is continued beneath, contrasting with the parts before and behind; eyes red. ♂ hatching at the end of March.

Hab.—Japan, on stems of *Edgeworthia papyrifera;* found by Mr. Alex. Craw in the course of his horticultural quarantine work. While the antennæ are but 7-jointed, the legs are those of a *Phenacoccus.*

(5). *Erium,* Crawford, ms. This name will stand for the subgenus of *Dactylopius* without lateral cottony tufts, forming complete separate cottony sacs. The type is *D. globosus* Maskell. The species are found in America, the Sandwich Islands, New Zealand, Australia and S. Africa.

(6). *Asterolecanium bambusæ* var. *bambusulæ,* v. nov.—♀ scale elongate-oval, 2 mm. long, 1 broad, dullish, not at all keeled, barely narrower behind than in front, where it is broadly rounded. Color very pale sulphur-yellow, dark at one end from the body of the ♀ showing through. Fringe short, pinkish, the pairs of rods mostly diverging at tips. ♀ turns in orange in KHO. Part of margin with a single row of glands, in pairs, but not actually touching, all very close together; and part with in addition a row of very small single glands, about three to each two pairs of the larger paired glands. Scattered glands elsewhere, not numerous.

Hab.—On stems 1⅔ mm. diam. of a small cultivated bamboo. Botanic Gardens, Grenada, West Indies, collected by Mr. W. E. Broadway, Nov. 16, 1895. One specimen is attacked by a dark brown fungus.

(7). *Pulvinaria simulans* Ckll.—Monterey, Mexico (C. H. T. Townsend). New to Mexico. Antennæ 7-jointed.

(8). *Lecanium ceratoniæ* Gennadios, 1895.—Found in Cyprus. The few words of description indicate *L. hesperidum,* to which this species must be referred, unless its author can show some reason to the contrary.

(9). *Lecanim flaveolum* Ckll.—From the original type lot I bred *Coccophagus flavoscutellum*, Ashm., identified for me through Mr. Marlatt.

(10). *Lecanium persicæ* (Fab.).—Montrose, Colo., sent by Prof. Gillette. New to Colorado. The material is poor, but I think my identification is correct.

(11). *Lecanium quadrifasciatum* Ckll.—The newly hatched larva is dark gray with a pale margin, and two longitudinal dark, dull pink bands. The larger stigmatal spines are quite large and stout, blunt, but not so long as the third joint of antenna, and so nothing to compare with those of *mirabile*. The species has never been found except at the type locality in the Organ Mts., N. M.

(12). *Physokermes insignicola* (Craw).—Mr. Alex. Craw kindly sent me ♂ scales of this. No ♀ scales came with them, so the determination rests with Mr. Craw. The males hatched at the end of March. Alive, they are black, or so dark brown as to seem so. Legs and antennæ brown, rather pale, especially the antennæ. The two white caudal filaments very long, nearly twice as long as body. Wings broad, reddish-hyaline, little colored, with a broad, very distinct pink subcostal stripe. Other particulars concerning this male have been given by Miss Tyrrell, and need not be repeated.

(13). *Pseudoparlatoria parlatorioides* (Comst.) and *Aspidiotus personatus* Comst., were both found by Mr. Alex. Craw on leaves of a cocoanut palm from Acapulco, Mexico. Both are new to Mexico.

(14). *Parlatoria theæ* var. *euonymi* Ckll., n. var.—♀ scale circular to oval, dark brown; exuviæ greenish-black; second skin circular, with an extremely narrow but well defined ochreous margin, hardly projecting beyond scale; first skin only slightly projecting beyond second. Scales removed from twig leave an obscure whitish mark. ♀ boiled in KHO turns green. Three pairs of distinct pale brownish lobes. Lateral groups of glands well apart, as in *theæ*. Plates between median lobes as in *viridis;* lobes and other plates as in *theæ* very nearly. The following table of the grouped ventral glands in *Parlatoria* may be useful:—

	euonymi	*theæ*	*viridis*	*calianthina*	*pergandii*
caudolaterals,	12–18	7	16–17	19	4–10
cephalolaterals,	21–23	20	9–16	16	4–10
median.	none	1	1–4	4	none

In *P. calianthina* Berlese, the median lobes are only notched without; in *euonymi* they are very strongly and about equally notched on each side, and *pergandii* has them nearly the same.

(15). *Aspidiotus juglans-regiæ* v. *albus* Ckll.—In fair quantity on an osage orange bush (*Maclura*) in Mesilla, March, 1897. Some showed parasite holes. The food plant is new.

(16). *Chionaspis citri* Comst.—On oranges from Samoa; found by Mr. Craw. A new locality, until reported last year by Mr. Craw. It was earlier known from Tonga.

(17). *Chionaspis braziliensis* Sign.—On a fern (seems to be a *Polypodium*) in a California green-house, largely parasitized; mostly ♂ scales. Sent by Mr. Craw. A new locality. It is probable that *brazilensis, aspidistræ* and *latus* are varieties of one species. These, with *C. minor*, form a distinct subgenus, in which the females resemble *Pinnaspis,* while the ♂ scales are those of *Chionaspis.* It may be termed *Hemichionaspis,* with *C. aspidistræ* as the type.

THE SEVENTH SESSION OF THE INTERNATIONAL GEOLOGICAL CONGRESS.

(4TH CIRCULAR).

RUSSIA, 1897.

As we have had the honor of announcing in our third circular addressed to all the members of the Congress, the number of participants in the excursions of the Ural, of Esthonia, and of the Volga has been necessarily limited. The committee of organization has found itself obliged to adopt this measure as much in consequence of the inadequate number of hotels as because of the necessity of having recourse to private houses for lodgings, or having to offer nothing but the cars for passing the night. This applies especially to the Urals where there will be great distances to be traversed in carriages in a region little populated and where the mining establishments have but few carriages to put at the disposition of excursionists. The participants in the excursion to the Ural will do well to take with them a pillow, a wrap (plaid), warm clothing, good boots, and an impermeable overcoat.

Actually the number of geologists desirous of taking part in these excursions considerably exceeds the number to which we must limit ourselves. The committee of organization finds itself in consequence, very much to its regret, in the sad necessity of not being able to admit all the requests, and (in the impossibility of satisfying every body) of giving preference to the persons who were the first to present themselves in answering the first circular of last year as well as the second.

The persons to whom participation in these excursions must be refused are notified of the fact by a special letter.

In order to avoid that geologists who have inscribed themselves conditionally for this or that excursion and who wish to abandon it, should deprive their fellow geologists of the possibility of taking part, the committee of organization begs them to notify it definitely whether or not they maintain their wish to participate in the excursions to be made before the Congress (to the Ural or to Esthonia).

From the 15 (27th) to the 18th (30th) of July delegates of the committee will be stationed at the Stations in Moscow of the Moscow-Brest, and Nicholas railways, to direct geologists coming from foreign countries to the place of meeting of the excursionists going to the Ural.

In sending the ticket giving the right to transportation in the first class on the Russian railways, the committee of organization permits itself to remind the geologists that the gratuitous tickets for the Russian railways will be good from the 10th (22d) of July to the 5th (17th) of October.

These tickets give the right to go from the frontier to the starting places of the excursions (St. Petersburg, Moscow, etc.), and to take part in all the parts of the proposed itinerary.

Similarly the tickets will be good for the return of the excursionists to the frontier starting from any point where they wish to leave the excursions of the Congress.

Conformably to the laws in force on the Russian railways the holder of gratuitous tickets are required:

1. Not to transfer them to other persons.
2. To present the ticket on request of the conductor of the train or of the management.
3. Each ticket gives the right to the gratuitous transportation of 1 pound (16 kilograms).

The committee of organization begs each possessor of a ticket, to sign it himself on the back near the bottom, at the line marked by a red point.

Persons who do not make use of the railway ticket sent them, are requested to return it to the committee by registered letter.

To the persons arriving by Finland, the tickets for transportation on the Finnish railways will be delivered by Mr. I. Sedorholm, Director of the Geological Survey of Finland, and member of the Committee of organization.

In the name of the general committee of organization.

THE BUREAU.

A. KARPINSKY, *President.*
TH. TSCHERNISCHEW, *General Secretary.*

RECENT LITERATURE.

A Text-Book of Experimental Embryology.[1]—Professor Morgan, of Bryn Mawr College, has made the first attempt to bring the results of the labors of German and American experimental embryologists into such form as may serve as an introduction to this rapidly growing branch of biology. The scattered and too often inaccessible

[1] The Development of the Frog's Egg. An Introduction to Experimental Embryology, by Thomas Hunt Morgan. The MacMillan Co., New York, 1897, pps. 186, 51 figs. in text. Price, $1.60.

notes and papers put forth by the enthusiasm of workers in this field are here brought to the hands of the student in a form at once intelligible and available; grouped about a concrete case, the development of a well known animal, the frog. But the book is less a compilation than the entire statement of the author's own researches on this subject complimented and illuminated by facts taken from other authors, having a direct bearing upon the frog's development, though sometimes going into wider fields for more definite illustration. It is an account of the development of the frog as seen from the point of view of the experimental embryologist, who desires to understand as well as to record his facts, and seeks information by direct, more or less pertinent, questions put to nature in the form of experiments. With the exception of certain treatises upon comparative embryology, we may regard this as the first attempt at a truly scientific text-book of embryology—as something more than a history of developmental stages—and it is noteworthy that America and not Germany has produced this as well as the two other important biological text-books recently issued by the same publishers.

The book will serve as a useful manual for advanced students and welcome reading for the many biologists who have not the time for direct study in this special field. How far it may lead to the gradual substitution of the life history of the physiologist's pet, the frog, in place of the development of the ever accessible chick in elementary biological instruction remains for time to show.

A brief summary of the leading chapters may convey some idea of the ground covered and the treatment of the subject. The first deals with the making of the egg and sperm, and is largely a compilation with free use of phenomena better known in other animals. The second describes the formation of the polar bodies and the process of fertilization. The third briefly reviews experiments upon cross-fertilization in frogs of different species. The fourth treats of cleavage and shows the author's special intimacy with this phase of the subject; there is not only a detailed description with excellent original figures, but also a most interesting comparison of the arrangements of cells in the cleaving of frog's eggs with possible combinations of oil drops as arranged in Roux's experiments. The author says: "It seems highly probable that surface tension is also an important factor in the segmenting egg, but other conditions present prevent its free play."

The fifth and sixth take up in detail the formation of the blastopore and the associated phenomena of concrescence and germ-layer formation; intricate problems clearly elucidated in the frog's case by aid of the author's own research. Additional evidence is presented in the next chapter which considers the abnormal embryos made in salt solutions in the experiments of Hertwig and of Morgan.

Two chapters discuss the effects of gravitation acting upon cleaving frog's eggs; first in the series of experiments of Pflüger and then in those of Born and of Roux. The tenth takes up the cleavage of eggs under pressure and concludes that in early cleavage the *nuclei are all equivalent.* The next throws additional light upon the nature of cleavage in presenting the work of Roux, Morgan and others, who have reared larvæ from eggs in which one of the first two cells has been injured. The intricacies of "post generation" are also set forth here.

The interpretations and conclusions of the twelfth chapter conclude that part of the volume dealing with experimental work, save that a short sixteenth chapter briefly gives the effect upon frog's eggs of light and of temperature.

Two added chapters continue the account of the frog's growth, and describe the formation of mesodermal and of entodermal organs, so that the book may serve as a substitute for Marshall's text-book, besides being an introduction to a new method of study.

In the twelfth chapter we find a very clear statement of Roux's mosaic theory and its modifications, a brief account of the conceptions of Driesch and of Hertwig, and the remarkable facts observed upon the Ctenophore egg. From experiments upon these eggs the author concludes that "in the protoplasm and not in the nucleus lies the differentiating power of the early stages of development."

The Roux-Weismann hypothesis of *qualitative* nuclear division is rejected as having "no known histological facts in its favor."

To reconcile the prevailing conception of the power of the nucleus with the idea that the differentiating power resides in the egg protoplasm outside the nucleus, the author suggests that the nucleus participates in determining form only so far as it controls the special character of an organ, while the main determination as to what part shall be one organ rather than another, is made by the non-nuclear part of the egg or cell. "After cleavage, the cytoplasm of each part differentiates into this or that organ, but the kind of differentiation of each part is determined by the nucleus of that part."

Touching the fundamental question as to the cause of differentiation the author says: "Driesch has pointed out that the egg seems to act like an intelligent being." If so, are the causes of differentiation and of regeneration the same in kind as physico-chemical causes, or do they belong to the category of intelligent acts, and can these latter be accounted for by *known* principles of chemistry and physics? The plain answer is, we do not know.—E. A. A.

Miocene Mollusca and Crustacea of New Jersey.[2]—This important work is published in the Monograph (Vol. XXIV) Series of the U. S. Geological Survey. Very little attention had been given to the Miocene molluscan fauna of New Jersey when Mr. Whitfield began a systematic study of it. A list published by Mr. F. B. Meek, a few species described by different writers, and the work done by Prof. Heilprin summarizes all the knowledge concerning this fauna up to 1887. The present work is based on the collections in the U. S. National Museum and the Philadelphia Academy of Natural Sciences. One hundred and four species are recognized and described, which, with the four species given in Prof. Heilprin's list and two species of Bryozoans in Meek's list would carry the number to one hundred and ten species. The species described are distributed as follows: Brachiopoda 1, Lamellibranchiata 61, Gasteropoda 39, Crustacea 1. All the species are figured on 24 page-plates.

Sixteenth Annual Report U. S. Geological Survey, Parts III and IV.[3]—This report forms the eleventh in the series Mineral Resources of the United States. Part III treats of metallic products containing the usual summary of recent developments in the knowledge of the mineral deposits, the amount produced, its value, etc. in this country, etc. and also in other countries which trade with the United States. Part IV embodies the latest information concerning the non-metallic products. The illustrations consist of maps, diagrams and figures in the text.

We are informed that the cost of printing and binding is no longer charged for this book, and that by making prompt application to a Senator or Representative the volume may be obtained, as the Congressional distribution of the book will soon ensue.

Glaciers of North America.[4]—In an octavo volume of some 210 pages Mr. Russell has condensed the existing knowledge of North

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[2] Monographs of the U. S. Geological Survey. Vol. XXIV. Miocene Mollusca and Crustacea of New Jersey. By R. P. Whitfield. Washington, 1894.

[3] Sixteenth Annual Report of the United States Geological Survey. Part III, Mineral Resources of the United States, 1894, Metallic Products. Part IV Nonmetallic Products. Washington, 1895.

[4] Glaciers of North America. By I. C. Russell. Boston and London, 1897. Ginn and Co., Pub.

American glaciers, besides giving brief descriptions of glacial phenomena in general. The closing chapter presents a view of the life history of an alpine glacier, of which representatives occur in abundance and in great variety in North America. The author instances the Seward glacier, Alaska, as the largest of this type that has ever been discovered. The Malaspina glacier, the great ice sheet which intervenes between Mt. St. Elias and the Pacific, represents a second or Piedmont type, and the still larger, or Continental glacier, is typified by a single example in Greenland.

The work is abundantly illustrated by maps, page plate pictures reproduced from photographs, and cuts in the text.

AMERICAN NATURALIST LIST OF RECENT BOOKS AND PAMPHLETS.

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——On the Deep-bodied Species of the Clupeoid Genus Diplomystus.

——On the Devonian Ichthyodornlite, Byssacanthus. Extrs. Ann. Mag. Nat. Hist. (6), XV, 1895.

——On some Remains of the Pycnodont Fish, Mesturus, discovered by A. N. Leeds, Esq., in the Oxford Clay of Peterborough. Extr. Ann. Mag. Nat. Hist. (6), XVII, 1896. From the author.

General Notes.

MINERALOGY AND CRYSTALLOGRAPHY.[1]

Lewisite and Zirkelite.—Hussak and Prior[2] have given these names to two new Brazilian minerals. The lewisite, named in honor of Prof. W. J. Lewis, of Cambridge, Eng., was obtained from the cinnabar mine of Tripuhy in the gravel occurring on a hill-slope near Ouro Preto, Minas Geraes, Brazil. Xenotime, cinnabar, monazite, zircon, kyanite, tourmaline, rutile, hematite, pyrite, magnetite, gold, lewisite and a new titano-antimonate of iron, not yet obtained in quantity sufficient for accurate determination, constitute the heavy sand obtained by washing the gravel with a " batea." Lewisite occurs in perfect honey-yellow to brown octahedra, seldom exceeding 1 mm. in diameter. Twinning on the plane 111 is rare. Translucent, isotropic, streak light yellow-brown, cleavage octahedral, hardness 5.5, lustre vitreous to resinous, specific gravity 4.95. A pulverulent sulphur-yellow decomposition product was sometimes observed on the surface and in cavities inside the crystals. The results of an analysis and the theoretical composition of 5 CaO, 3 Sb_2O_5, 2 TiO_2 are given as follows:

Sb_2O_5	67.52	68.42
TiO_2	11.35	11.70
CaO	15.93	19.88
FeO	4.55	
MnO	.38	
Na_2O	.99	
	100.72	100.00

The lewisite is thus most closely related to Mauzeliite, an isometric mineral described by Sjögren (Geol. Fören. Förhand. Stockholm, XVII, pp. 313–318, 1895). Mauzeliite is brown, with Sp. G. 5.11, and gave, on analysis, Sb_2O_5 59.25, TiO_2 7.93, PbO 6.79, FeO .79, MnO 1.27, CaO 17.97, MgO .11, K_2O .22, Na_2O .27, H_2O .87 and F 3.63 (by difference ?). The Swedish mineral contains much more lead and fluorine and less iron than that from Brazil.

The name zirkelite is given to a black, isometric, nearly opaque titano-zirconate of calcium and iron which occurs in the form of octahedra with baddeleyite, perofskite, etc., in the decomposed magnetite-pyroxenite of Jacupiranga, Sao Paulo, Brazil. Its density is 4.706, its hardness 5.5, and an analysis gave ZrO_2+TiO_2 79.79 (48.90+30.89?), FeO 6.64, CaO 11.61, MgO .49, loss on ignition 1.02, total 99.55. Note of this mineral without proposal of a name was earlier made by Hussak in Tschermak's Min. Pet. Mitth., XIV, pp. 408–410.

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[1] Edited by Prof. A. C. Gill, Cornell University, Ithaca, N. Y.

[2] Min. Mag., Vol. XI, Sept., 1895, pp. 80-88.

Epidote and Zoisite.—In connection with a somewhat detailed study of four alpine occurrences of epidote and zoisite, Weinschenk[3] proposes the name *clinozoisite* for those monoclinic members of the zoisite-epidote group which approach zoisite in chemical composition, are optically positive, and have a less index of refraction and a less double refraction than ordinary epidote. A beautiful new occurrence of clinozoisite at the Goslerwand in the Tyrol furnishes crystals of a delicate rose-red color. Their crystal form coincides with that of epidote. An analysis gave:—

SiO_2	39.06
Al_2O_3	32.57
Fe_2O_3	1.68
FeO	.29
MnO	trace
CaO	24.53
H_2O	2.01
	100.14

The indices of refraction are $\alpha=1.7176$, $\beta=1.7195$, and $\gamma=1.7232$. Hence the double refraction $\gamma-\alpha=.0056$, which is the lowest value ever recorded for a monoclinic epidote. The optical angle is:— $2V_{Li}=80° 50'$, $2V_{Na}=81° 40'$, and $2V_{Tl}=$ about 83°. Sp. G. 3.372.

The Monoclinic Pyroxenes of New York State.—These, with the exception of wollastonite, are quite fully discussed by Ries,[4] who gives also an extended bibliography of the subject. The aluminous augites of New York show more frequently an exception than an agreement with Tschermak's suggestion that Ca is less than Mg+Fe. Most of the large mineral collections which were likely to contain much material from New York were consulted in the course of these studies, so that the list of localities is doubtless very complete.

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[3] Zeitsch. f. Kryst., XXVI, pp. 156–177, 1896.

[4] Annals N. Y. Acad. Sci., IX, pp. 124–178, June, 1896.

On the Zonal Structure of Crystals.—Pelikan[5] discusses the peculiarities of augite, barite, cassiterite, calcite, tourmaline and fluorite as regards their growth in zones. Of these, the first two are especially interesting. The literature on the hour-glass and zonal structure of augite is reviewed, after which are given the results of work on the well-known "hourglass" augites of Nordmark. This structure has been shown to be due to the varying conditions of deposition on the various faces of a growing crystal. That portion of the augite substance which was deposited on the orthopinacoid is found to be darker in color and to have a larger angle between $\dot{c}$ and c than the material which grew on the base or orthodome. In the darker portions this angle is greater for violet than for red rays, while in the lighter parts the reverse is true. Etched figures show a hemihedral symmetry for some pyroxenes, thus confirming observations that have been made, in rare cases, on the crystal form. In barite the crystal faces show a selective force, so that hematite and cinnabar, for instance, are found chiefly on the macrodome (101). So far as known, there are always other than isomorphous molecules present in those cases where different substances are deposited on different face.

After classifying the various causes of zonal distribution of color in crystals, the conclusion is drawn that hourglass structure is never caused by an intermixture of isomorphous substance, but by the presence of some differently crystallizing coloring matter, or by a "dilute color."

Miscellaneous Notes.—With the close of the year 1896, came the last brochures of the second volume of Hinze's *Handbuch der Mineralogie*, already referred to in the NATURALIST, Vol. XXV, 1891, p. 577. This second volume (the first has not yet been published) treats only the silicates, devoting more than 1800 pages to the discussion of these minerals alone. It is by far the most complete, as well as the most recent, work of its kind. The appearance of the first volume will be looked for with much anticipation by mineralogists. It is published by Veit & Co., Leipzig.

A. P. Brown[6] finds, on some unprecedentedly fine molybdenite crystals from Frankford, Pa., the axial ratio a : c=1 : 1.908. The faces observed are: c (0001, °P), o $(10\bar{1}1, P)$, p $(20\bar{2}1, 2P)$, q $(30\bar{3}1, 3P)$, and m $(10\bar{1}0, \infty P)$. The angle c : p=77° 13′. The pyramid p $(20\bar{2}1)$

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[5] Tschermak's Min. Pet. Mitth., XVI, pp. 1–64, 1896.

[6] Proc. Acad. Nat. Sci. Philadelphia, 1896, pp. 210–211.

is more common than the unit pyramid. The etched figures on the base indicate hexagonal, or possibly rhombohedral symmetry.

In agreement with the observations of de Bournon, Bauer and others, Judd[7] considers the structural planes of corundum to be not true cleavages, but simply planes of parting. Those parallel to 0R (0001) and ∞P2 ($11\bar{2}0$) are thought to be normal solution planes, while the set parallel to R ($10\bar{1}1$) are explained as gliding planes which, after the gliding under pressure, have become secondary solution planes. Observations on the shape and crystallographic position of the solution cavities are recorded. These are either empty or filled with the products of alteration.

Spencer[8] gives a full list of the literature of enargite, as well as of its places of occurrence. He cites for the first time the ten new planes, (610), (520), (540), (230), (108), (207), (709), (301), (601) and (054). Of these (610) and (601) are noted as doubtful. The mineral clarite (Sandberger, N. J. B., 1874, p. 960 and 1875, p. 382) is considered to be identical with enargite.

The relationships of the members of the humite series are reviewed by Lewis,[9] who brings the orthorhombic pyroxenes, as well as olivine, into the discussion. Besides the well-known progression in the axial ratios, the remarkable fact is noted that the twin face in all these minerals is parallel to the b axis, and in all except clinohumite it makes an angle of about 30° with the base (001). In clinohumite it has a position about at right angles to that in the other minerals. Another common feature is the great predominance of forms lying in the zones 010, $\bar{1}10$ and 210. The minerals are similar in density, hardness and fusibility. The moleculare volumes are:—

Enstatite, 32.8 = $\frac{3}{2}$ x 21.9
Olivine, 44 = 2 x 22
Chondrodite, 105.6 = 5 x 21.1
Humite, 150 = 7 x 21.4
Clinohumite, 182.1 = 9 x 20.2

(*Note.*—The molecular volume of clinohumite is probably too low, as given here. From the first three minerals one might compute the volumes of MgO (11.2), SiO_2 (21.6), and $Mg_2O(OH, F)_2$ (28.8). This would give for humite the molecular volume 149.6, and for clinohumite, 193.6.)

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[7] Min. Mag., Vol. XI, Sept., 1895, pp. 49–55.

[8] Min. Mag., Vol. XI, Sept., 1895, pp. 69–79.

[9] Min. Mag., XI, Oct., 1896, pp. 137–140.

PETROGRAPHY.[1]

Ancient Volcanic Rocks in Pennsylvania.—Reference has already[2] been made in these notes to the discovery of ancient acid and basic volcanic lavas and tuffs at South Mountain, Pa. Miss Bascom[3] has recently given an exhaustive account of all the types of these rocks, which account is beautifully illustrated by reproductions of microphotographs and of colored drawings, and by a large scale geological map. The volcanic lavas are partly devitrified rhyolites and partly altered basalts. A brief notice of the former was given several years ago.[4] The present report adds much of detailed information concerning them to that already imparted, but nothing of general interest. These lavas are pre-Cambrian, and are probably older than the basic rocks with which they are associated in the Monterey district. The basic lavas were originally diabases, augite-porphyrites and melaphyres. They have suffered extreme alteration in consequence of weathering and also as a result of squeezing. Nearly all the rocks are schistose, the most highly schistose ones being now practically slates.

Rocks Associated with the Magnetites near Port Henry, N. Y.—The rocks associated with the non-titaniferous magnetites at Mineville and near Port Henry, N. Y., are described by Kemp[5] as gneisses and gabbro. Four varieties of the gneiss are distinguished, of which three are acid and one basic. One of the acid gneisses consists of quartz and plagioclase exclusively. Another is composed of these minerals and a large proportion of micro-perthite, and the third of brown hornblende, green augite and rarely hypesthene, in addition to the feldspars and quartz. The basic gneiss is a schistose gabbro. It grades into the massive gabbro. In some phases hornblende and much garnet are present. All the gneisses, as well as the gabbro, are thought to be igneous in origin and to be pre-Cambrian in age. The ore deposits are on the contact of the acid and the basic rocks. While their method of origin is not certainly known, it is believed by the author that the ores may be contact products resulting from the action of the intrusive gabbro upon the gneisses intruded by it.

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] American Naturalist, 1894, pp. 515, 517 and 949.

[3] Bull. U. S. Geol. Survey, No. 136, Washington, 1896.

[4] American Naturalist, p. 515.

[5] Trans. Amer. Inst. Min. Eng., 1897.

The Basalts of Klöch in Steiermark.—The main portions of the Klöch Mountain mass are basalts and their tuffs. Sigmund[6] describes these and the other rocks in their vicinity as nepheline basanites, palagonite tuffs, nephelinites and nepheline basalts.

All the augites in the basanites have the "hourglass form," and all the feldspars are bytomites. The augites are also zonal with a colorless nucleus and a violet-gray peripheral portion. The extinction of the nucleus is higher than that of the surrounding portion, and the extinction in the pyramidal zone of growth (Anwachs-Kegel) greater than that in the prismatic zone. The nephelinite of the Hochstraden contains two augites. The larger consists of colorless nuclei and greenish-yellow peripheral zones, while the smaller ones are composed entirely of the greenish-yellow material. Hauyn is an essential component of the groundmass. In some specimens it occurs in as large quantity as the nepheline. An analysis of this rock gave:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	SO_3	Cl.	Loss	Total
40.99	2.41	16.50	10.62	,35	3.29	12.63	5.95	2.36	.89	.64	.36	2.63	= 99.62

The basalt of Klöch and the nephelinite of the Hochstraden are thought to have been produced by the differentiation of one magma.

The Volcanic Rocks near Bensen, Bohemia.—Hibsch,[7] in his description of the Bensen sheet of the Bohemian Mittelgebirge, gives brief accounts of the basalts, augitites, tephrites, basanites, phonolites and trachytes occurring as lavas and tuffs, and of the camptonitic, trachyte-andesitic and tinguaitic dykes so common in the district. The basalts, which are the oldest lavas, form stocks, sheets and dykes; the tephrites, which are the next older, occur in sheets and as tuffs, and the phonolites and trachytes as bosses. The tinguaite dykes are connected with the phonolitic intrusion at Mühlörzen, but the others are more closely connected with the volcanic center at Rongstock. All the eruptives are Tertiary or younger. The most interesting of these rocks is in the trachyte-andesite dyke. The author describes it under the name of gauteite, and regards it as the complementary form to the monchiquites. It is a rock of a light color and trachytic habit. In composition it differs from bostonite-porphyry in the possession of phenocrysts of plagioclase. It consists of large porphyritic crystals of hornblende, augite, plagioclase and occasionally biotite in a groundmass composed of the same dark minerals, sanidine and andesine, cemented by glass. An analysis yielded:

[6] Min. u. Petrog. Mittheilungen, XV, p. 361 and XVI, p. 337.

[7] Ib., B., XVII, p. 1.

Si_2O	Ti_2O	P_2O_5	Al_2O_3	Fe_2O_3	Feo	CaO	MgO	K_2O	Na_2O	H_2O	Total	
54.15	tr.	.41	18.25	3.62	2.09	4.89	2.56	6.56	4.43	3.69	= 100.65	Density = 2.632

The basalts include feldspathic, nephelinic and magma basalts, analysis of the first two of which are here given:

SiO_2	TiO_2	P_2O_5	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O	CO_2	Total
42.75	2.13	tr.	17.24	8.10	5.88	11.14	6.17	2.48	4.21	1.06		= 101.16
39.33	1.01	.93	15.26	6.36	5.99	14.52	9.78	1.53	3.47	2.54	0.12	= 100.84

The tephrites are phonolitic and basaltic hauyne-tephrites, sodalite-tephrites, nepheline-tephrites and leucite-tephrites. The phonolite contains great quantities of anorthoclase in large crystals. Some phases of the rock are noticeable for their phenocrysts of sodalite and others for their phenocrysts of nepheline. The other rocks possess no special features.

The Law Governing the Production of Zonal Crystals.—The law governing the occurrence of zonally developed crystals is as follows, according to Becke[8]: In the zonally developed isomorphous mixed crystals of igneous rocks the more difficultly fusible components constitute the nuclei, and the more easily fusible ones the peripheral zones of the crystals.

Petrographical Notes.—Diller[9] has discovered a boulder of hornblende-basalt in Kosk Creek at the great bend of Pitt River in Shasta Co., Cal. It is interesting not so much because of its features, but because of the rarity of the type in the district. An analysis yielded:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	P_2O_5	Total
44.77	.53	17.82	5.05	6.95	tr.	10.36	8.22	.92	2.13	2.64	.72	= 100.11

The Seychelles Islands in the Indian Ocean are described by Bauer[10] as being composed principally of hornblende, granite and of syenite cut by dykes and covered in places by sheets of granite-porphyry, felsite-porphyry, syenite-porphyry, hornblende-vogesite, diorite, quartz-diorite, diabase, melaphyre and dolerite. The sedimentary rocks on the island are in very small quantity. They consist mainly of andalusite-hornfels and other contact rocks.

[8] Min. u. Petrog. Mitth., Vol. XVII, 1897, p. 97.

[9] Amer. Geologist, Vol. XIX, 1897, p. 253.

[10] Sitzb. Ges. z Beförd gesammnt. Naturw. zu Marburg, Feb., 1897.

GEOLOGY AND PALEONTOLOGY.

Geology of Alaska.—In a report on the Coal and Lignite of Alaska Dr. Dall publishes some general notes on the Cenozoic geology of the Territory. In general, the sequence of rocks along the southeastern coast where undisturbed is about as follows, in descending order:

"1. Soil and Pleistocene beds."

"2. Brown Miocene sandstones, with marine shells, cetacean bones, and water-worn, teredo-bored fossil wood (Astoria group, Nulato sandstones, Crepidula bed)."

"3. Beds of conglomerate, brown and iron-stained, alternating with gravelly and sandy layers, the finer beds containing fossil leaves of Sequoia and other vegetable remains. (Kenai group, Nuga beds)."

"4. Bluish sandy slates and shales, with rich plant flora, interstratified with beds of indurated gravel, fossil wood, and lignitic coal (Kenai group)."

"5. Metamorphic quartzites and slaty rocks, with perhaps part of the lower Eocene (Tejon)."

"6. Granite and syenite in massive beds, usually without mica and apparently in most instances forming the " back bone " of the mountain ridges or islands, but occasionally occurring as instrusive masses, which have thrust up the metamorphic rocks above them into arches, cracking them, and filling the fissures with the syenitic material. ("Sumagin granite)."

The author correlates the Kenai group with the Oligocene of European geologists. The beds overlying the Kenai conglomerates and leaf beds are undoubtedly Miocene. Mr. Dall concludes from a comparison of their fauna with modern forms that in Miocene times the waters of this region were warmer than at present.

The Pleistocene epoch is marked in Alaska, as in California, by great changes of level, and by volcanic activity. To this period is assigned the ground ice formation which has been recognized in many places in the northern part of Alaska. This consists of solid beds of ice of considerable thickness, functioning as rock strata, which are covered by beds of blue clay containing remains of Pleistocene mammals, or by beds of alluvium which sustain a layer of turf, with ordinary profuse herbage of the region, or even small thickets of birch, alder, and other small Arctic trees.

The paleontology of the Territory is made the subject of special papers by Knowlton, Schuchert, and Hyatt which appear as appendices to Dr. Dall's report. The fossil flora embraces 115 forms, the most of which appear to be of Eocene or Oliogocene age. Mr. Knowlton concludes from a comparison of the Alaskan fossil flora with that of Greenland Spitzbergen and the island of Sakhalin that they are all so closely related that they probably grew under similar conditions and were synchronously deposited.

Faunal collections from Alaska are meager. As yet a few forms only, representing Silurian, Devonian, Carboniferous and Mesozoic beds, are known. According to Hyatt, the existence of the Cretaceous has not yet been demonstrated in Alaska, unless the Ancellæ described by Eichwald are Cretacic species. (Seventeenth Ann. Rept. U. S. Geol. Survey Pt. I, Washington, 1896.)

Phylogeny of Dæmonelix.—The strange fossil, popularly known as Devil's Corkscrew, has been of interest since its first discovery in 1891. During a recent expedition to the Loup Fork Tertiary Mr. E. H. Barbour made a study of these fossils *in situ* where a succession of them were exposed in a canyon. In passing from the lower beds to the higher forms varying from simplicity and uniformity to those of ever-increasing diversity and complexity are found, the climax being reached in the topmost beds. The simplest form of the Dæmonelix series is a hollow tubule or fiber, and the author's belief is that it is according to the arrangement or aggregation of these fibers that the multifarious forms result.

The second form, for lack of a better name, is termed "Dæmonelix Cakes." They are commonly circular in form, 5 to 10 centimeters across, and form ½ to 2 centimeters thick. They lie in horizontal planes through a vertical range of some six to eight meters. Overlying these were "balls," very similar to the preceding forms, but smaller in circumference and of greater complexity structurally.

The third form resembles cigars or fingers. In outward appearance they have acquired a pronounced vertical habit and a noticeable tendency to a spiral form. They are about the size of an ordinary cane. These are succeeded by an irregular spiral form, found through a vertical range of six to eight meters in the middle beds. This form, as well as the preceding, ends in blunt rounded terminations sealed or capped with fibers, leaving neither exit or entrance for supposed occupants of so-called burrows. Lastly we have the "Dæmonelix regular." A sheer wall exposes to view a section 40 to 45 meters from bottom to top, with innumerable twisters at every level. Those at the bottom are constructed upon smaller and more uniform lines and stand in bold contrast to the large and diversified forms at the top.

Microscopic sections from all the five forms to the number of 120 demonstrate the fact that there is an apparent similarity of tissue in all and that it is cellular, but not vascular. Mr. Barbour's conclusions relate only to the first three forms and the surface structure of the great cork screws. The central spiral tube is under consideration. He suggests that it may represent the root of some higher plant about which the original Dæmonelix fibers grew. (Bull. Geol. Soc. Amer., Vol. 8, 1897.)

The Nature, Structure and Phylogeny of Dæmonelix.[1]—Prof. Barbour brings forth in this, his latest paper on the peculiar fossil popularly known in the region where it is found as the "Devil's corkscrew," additional evidence to support his already well supported conclusion that the fossil is that of an aquatic plant. The figures that he gives of sections showing plant parenchymatous cells in cross and in longitudinal section are much superior to any that he has previously published. The evidence that they form, together with the evidence of slides sent the writer, is conclusive. The fossil was a plant and is not the mould of the roots of some plant.

But in this and in a preceding paper[2] Prof. Barbour goes further than previously and cautiously claims to be able to make out the phylogeny of the fossil. At the bottom of the beds in which Dæmonelix occurs there are to be found irregular filamentous remains; above these, cake-like masses; above these, large irregular root-like forms that gradually metamorphose into regular screw-like forms. All present the same parenchymatous cellular structure when viewed in carefully made sections beneath the microscope. The author's idea is a bright, and it may be added, a daring one—daring in view of the tremendous change that is claimed to have taken place within the brief interval of geological time represented by the 250 to 300 feet of sediment forming the fossil bed. According to ideas more or less generally accepted, if the writer mistakes not, the waters of the great pliocene lake in which these fossils flourished are supposed to have been comparatively heavily laden with sediment, and as the structure of the beds shows, that it was deposited rapidly. The change from the filamentous fossils to the well formed Dæmonelix is as great, or greater perhaps, than the difference between a simple infusorian and a sponge, or as that between a simple Spirogyra and a Fucus. No where in the animal kingdom and nowhere else in the vegetable kingdom is there to be found paleontological evidence of so rapid a change.

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[1] E. H. Barbour, Bul. Geol. Soc. Amer., VIII, 305–14. Reprint from the author.

[2] History of the Discovery and Report of Progress in the study of Dæmonelix. University Studies, Lincoln, Nebraska, Jan., 1887., II, 81–125.

Yet it must be admitted that, although the rapid change required weighs heavily against Barbour's suggestion, it does not form a conclusive argument. Both animals and plants are known to yield readily to surrounding physical conditions, and great and anomalous changes are known to occur at a single leap as it were in many of the cases that fall under what we commonly call monstrosities. Granting that the change indicated by the series that the author thinks he has demonstrated is a possible one, there remains the greater and more important task of showing the existence at the time that these fossils plants were growing of causes adequate to produce it. This done the author's hypothesis will be practically unassailable.

In as much as the plants were aquatic one would not, judging from the analogy of aquatic organisms in other instances, expect so rapid a change as in the case of land plants. Climatic conditions could doubtless have had but little influence. One is, therefore, left to inquire what changes may have occurred in the character and the quantity of the salts that the water of the lake held in solution, or of the sediment that it carried. As the writer remembers the fossil beds in question there is no very apparent evidence of a change in the character of the sediment. The beds are not laminated. The structure from bottom to top is throughout remarkably and uniformly of the same peculiar mixture of fine, indurated, calcareous sand. And it seems, therefore, that, if any cause is to be found, it must be looked for in the character or amount of the salts that were poured into and remained in the lake. As yet no one has shown that the silicious material of which the fossils are composed is more abundant at one level in the beds than at another, and the same may be said of the magnesium, potassium and other salts.

Evidently there is much work yet to be done in solving this Dæmonelix riddle notwithstanding the great amount of labor that Prof. Barbour has already expended upon it, and it is to be hoped that he will find the necessary time and encouragement for continuing his work both in the field and in the laboratory. Besides an answer to the questions implied in the foregoing remarks there are needed answers to other questions regarding the structure of the fossil.—F. C. KENYON.

Origin of the Edentates.—Dr. Wortman has come into possession of material which, in his judgment demonstrates the genetic relationship of the Ganodonta to the later appearing American Edentata. In considering the Ganodonta the author points out the features which characterize the genera composing the family and which become more and more marked as the respective phyla advance into later time. These features relate to the loss of the incisors, the weak development and loss of the enamel, and the development of hypsodonty with its dependent modification growth from a persistent pulp. Of one phylum, viz. the Stylinodontidæ, Dr. Wortman has remarkably complete record, beginning in the generalized type Hemiganus of Lower Puerco, and continued into the Bridger, terminating in Stylinodon. In a comparison of this group with the Ground Sloths (Gravigrada) the author enumerates 17 points of resemblance which he considers sufficient evidence to demonstrate that the one has descended from the other. The next inference then is that all the South American Edentates must have been derived from the North American Ganodonta, since their earliest appearance in South America does not antedate the Santa Cruz epoch. But this necessitates a land bridge between North and South America during Eocene times, which is contrary to the accepted belief among geologists. In closing Mr. Wortman defines the order Edentata and its three suborders, Ganodonta, Xenarthra and Nomarthra with their families, and distinguishes the genera of the Ganodonta. (Bull. Amer. Mus. Nat. Hist., Vol. IX, 1897.)

Gypsum Deposits of Kansas.—The following information concerning the gypsum beds of Kansas was obtained by Mr. G. P. Grimsley during a field investigation of the region in which they occur:

"The gypsum beds of economic importance in Kansas are all Permian in age, ranging from middle Permian or Neosho to the close. They cover a belt approximately 200 miles long, 10 miles in width at the north, 20 miles in central Kansas, and 60 miles in the southern part of the state. The deposit is 8 feet thick in northern Kansas, 14 feet in the central area, 25 feet in the southern area, and even thicker further south. The northern and central rock gypsum was deposited in the same gulf cut off from the western Permian sea, while the gypseous dirt deposits are secondary and of recent age. The southern deposit was formed in a shallow bay cut off from the Permian sea, not far from the close of Permian time. Salt appears to have been deposited in these bays, but now it is only found farther out in the old gulf." (Bull. Geol. Soc. Amer., Vol. 8, 1897.)

Geology of the Funafuti Coral Reef.—The following summary is given by Mr. Hedley of the geological results of his observations while attached to the Funafuti Coral Reef Boring Expedition:

"(a) An elevation of Funafuti by at least 4 feet is proved by dead sub-fossil reef-corals in the position of life near high water-mark. (b) Darwin's theory of coral reefs, as opposed to Murray's, is favored by these facts: (1) Soundings show the atoll to be planted, not on a bank, but on a cone; (2) they also show it girdled by a precipitous submarine cliff, explicable only on the subsidence theory; (3) our observations and the experience of residents agree that the lagoon is filling up, whereas Murray demands its excavation, (c) A peripheral growth at present level is indicated on both sides of the islets." (Mem. III, 1897, Australian Museum.)

Geological News.—GENERAL.—Two kinds of mountain ranges are recognized by Dr. LeConte, classified by their generating forces. The one is anteclinal, the other monoclinal. As to cause the one is formed by lateral squeezing and strata-folding, the other by lateral stretching, fracturing, block-tilting, and unequal settling. As to place of birth, the one is born of marginal sea bottoms, the other is formed in the land crust. (Bull. Geol. Soc. Amer., Vol. 8, 1897.)

The fossil phyllopod genera, Dipeltis and Protocaris, according to Schuchert, are representatives of the Apodidæ family. The history of this family, therefore extends throughout the time of the entire known fossil-bearing rocks, as Protocaris occurs at the base of the Lower Cambrian. The fossil forms are generally marine, while all the recent species are denizens of fresh water ponds and pools. (Proceeds. U. S. Natl. Mus., Vol. XIX, 1897.)

PALEOZOIC.—In a revision of the fossil sponges found in the Quebec Group at Little Metis on the St. Lawrence River, Sir Wm. Dawson describes 14 species all belonging to the order Silicea. Of these, one, *Lasiothrix flabellata,* is new. Other animal remains from the same deposit are a small brachiopod, *Obolella pretiosa,* trails and castings of worms, and fragments of triobites, cystideans and Graptolites. (Trans. Roy. Soc. Canada, 1896–97.)

Some interesting vertebrate remains from the Kansas Permian are recorded by Williston, representing the genera Cricotus and Clepsydrops Cope. The characters do not warrant specific distinction from forms described by Cope from Danville, Illinois. The author calls attention to the close resemblance of the two series of forms and considers it a demonstration of the contemporaneity of the Illinois and

Kansas beds, as well as those of the Texas Permian, whence species of these genera have been described by Cope. (Kan. Univ. Quart., Vol. VI, 1897.)

MESOZOIC.—For the full classification of the Cycadaceæ Dr. Lester Ward proposes to use that term to represent the entire family, both living and fossil, and to subdivide it into the two subfamilies, the Cycadeæ for the living forms and the Cycadeoideæ for the fossil forms. Dr. Ward adopts this form of classification in his descriptions of species of fossil Cycads from the iron ore belt, Potomac formation of Maryland. In this collection seven species are recognized, of which six are new. (Proceeds. Biol. Soc., Washington, Vol. XI, 1897.)

The Museum at Caen, France is in possession of four reptiles from the Jurassic deposits of Normandy. These are identified by M. Bigot as *Steneosaurus roissyi* E. Desl., *S. intermedius* (n. sp.), *S. hebertii* Morel de Glasville and *Suchodus durobrivensis* Lydekker. All the specimens are fully described, and the new species figured. (Bull. Soc. Geol. de Normandie, t. XVII, 1896.)

The University of Denver has come into possession of a fossil Mosasaurid found near Flagler, Colo. It is interesting from the fact that there has been but one other Mosasaurid found in Colorado and also from the fact that it seems to be a new species.

It was thought, until within a year, that the Mosasaurids did not inhabit the ancient seas of Colorado, but existed only further toward the east. A few months ago, some bones which were probably from a Mosasaurid were found near Canyon city. These and the bones which I have, prove that the reptiles lived in the seas of Colorado.

From all I am able to learn of the reptile, I must conclude that it is a new species. It is possibly of the genus Clidastes. The description of this genus corresponds fairly well, though there seems room for doubt. The absence of characteristic parts makes the identification uncertain.

The vertebral column is about five meters in length and is composed of ninety vertebræ. Some parts of the jaw and limbs are also preserved. The authorities at the National Museum, Washington, to whom I sent some of the bones, write that I "probably have one of the most complete vertebral columns of this group of marine reptiles (Clidastes) in existence. The tail is particularly fine and gives me a much better impression of the depth and compression of this part of the body."—W. T. LEE.

CENOZOIC.—The following is the history of Crater Lake, Oregon, as worked out by Mr. J. S. Diller.

During the early glacial period Crater Lake did not exist, its site being occupied by an active volcano, Mt. Mazama. During the final great eruption of this volcano its summit caved in giving rise to a caldera nearly six miles in diameter and four thousand feet deep. Upon the bottom of the caldera volcanic activity continued. There were new eruptions forming cinder cones and lava fields partially refilling the great pit. Volcanic activity ceasing, the conditions were favorable for water accumulation and Crater Lake was formed in the pit. (Amer. Journ. Sci., Vol. II, 1897.)

From a study of parts of Labrador and Baffin Land Mr. R. S. Tarr concludes that all of that region, except possibly, the highest parts, has been buried beneath an ice sheet and there is evidence that the ice has withdrawn from these regions in very recent times. Down cutting of the surface by glacial action is more marked in Labrador than in Baffin Land. Post-glacial weathering is very pronounced in both regions. (Amer. Geol., Vol, XIX, 1897.)

BOTANY.[1]

Botanical Society of America.—The Third Annual Meeting of the Society will be held in Toronto on Tuesday and Wednesday, August 17th and 18th, 1897, under the presidency of Dr. John M. Coulter. The Council will meet at 1 P. M. on Tuesday, and the first session of the Society will begin at 3 P. M. The address of the retiring President, Dr. Charles E. Bessey, will be given on Tuesday evening at 8 o'clock.

The British Association for the Advancement of Science will meet in Toronto, August 18th to 25th. The opening address is to be given on Wednesday evening, August 18th. Professor A. B. Macallum, President of the Local Executive Committee, writes:

"A great many of the members of the Botanical Section of the B. A. A. S. are booked to leave Liverpool August 5th. They will arrive in Quebec and Montreal, if they make the usual time, by the 14th and 15th respectively, and will be in Toronto on Tuesday evening (17th) at latest. Some may stay over at Montreal and Ottawa and possibly

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

Kingston, arranging to arrive in Toronto Wednesday morning. The latter date will find nearly all of them here. Those who do not come via Quebec will turn up in Toronto at an earlier date probably. We expect a fairly large contingent, including some continental botanists of note."

It is expected, therefore, that this meeting will give unusual opportunities for renewing or forming acquaintances among British and continental botanists. By authority of the Council all foreign botanists present will be invited to sit as associate members of the Society and to read papers. This invitation will be addressed personally to all whose intention to come Toronto is known, and will also be published in *Nature* and the *Journal of Botany.*

A later announcement will contain information regarding R. R. rates, hotels, rooms for meeting, and other business to be submitted to the Society.—C. R. Barnes, *Secretary.*

Botany in the National Educational Association.—It is encouraging to notice that in the great gatherings of teachers modern methods in science teaching are receiving attention. Last year in the Buffalo meeting of the National Educational Association, Professor Atkinson, of Cornell University, and Professor Spalding, of the University of Michigan, discussed the educational value of botany. This year in the Milwaukee meeting Professor Barnes, of the University of Wisconsin, is to read a paper on "What can the High School do with Botany?" It is to be hoped that the masters in botany will continue to take part in these discussions. The teachers in the secondary schools are quite generally ready to receive suggestions as to better methods when given by those who are entitled to speak with authority.

Charles E. Bessey.

The Marine Biological Laboratory at Wood's Holl, Mass.—The tenth season of this useful laboratory is announced. The botanical instruction will cover a period of six weeks from July 6th, and will be conducted by Dr. Bradley M. Davis, of the University of Chicago. Two courses will be offered, viz., (1) on Elementary Botany, and (2) on the Morphology of the Algæ. In the first one week each will be given to Algæ, Fungi, Bryophytes and Pteridophytes, and two weeks to the Spermatophytes. There should be many students in attendance. The botanical advantages of Wood's Holl should attract many of the teachers in the High Schools and smaller colleges.

Charles E. Bessey.

A New Beginner's Botany.—In a neat little volume published by The Macmillan Company, Professor Setchell has given us his ideas of laboratory practice for beginners in botany. These successive volumes from the professors of Botany in the universities are interesting, since they show us what their authors think can be done in the secondary schools under present conditions. They are thus contributions to the science of education, and ought to be judged accordingly.

In this book Professor Setchell puts before us his plan of presenting elementary botany to beginners, resting it upon two general conclusions reached after experience "with a number of classes of beginners both in the preparatory schools and the university" as follows:

"Botany in the preparatory schools should be taught—

"1. As a science, to cultivate careful and accurate observation, together with the faculty of making from observations the proper inferences; and

"2. As a means of leading the mind of the student to interest itself in the phenomena of nature for its own further development and profit."

These are certainly sound principles, and we may welcome the book as the author's exposition of them. Upon opening it at page 1, we find that the pupil is directed to "take a ripened pod of a Bean Plant, and splitting it open, notice:

"1. That the seeds (Beans) are attached along one edge of each valve (or half) of the pod.

"2. That each bean is attached to the pod by a short stalk, the *funiculus.*

"3. Make a sketch of a valve of the bean pod with its enclosed beans, representing and labelling the parts."

In this way the separate beans are taken up and their details worked out until the pupil has a knowledge of the pod, valves seeds, funiculus, hilum, strophiole, seed-coats, raphe, micropyle, chalaza, embryo, cotyledons, caulicle, plumule, etc. Peas, Castor-beans, Morning-glory seeds, Indian Corn, Onion seeds, and seeds of Piñon Pine are to be taken in succession and studied in like manner. Then seedlings are studied, followed by roots stems, leaves, (including phyllotaxy) and buds. Next follow chapters on protection (thorns, spines, hairs, bitter or acid juice), storage (in roots, bulbs, leaves, etc.), climbing plants, epiphytes, parasites, saprophytes and insectivorous plants, in which the pupil is made acquainted with these various subjects by a laboratory study of fresh examples. Thus the author leads the pupil on through the structure of flowering plants, always by means of actual examples.

The book thus emphasizes the principle that botany is the study of *plants,* not the study of *books.* Books, however, are not to be ignored or neglected, and short lists of desirable reference books are given. It is significant of the spirit of the book that it is only "when the student shall have finished a careful study of the morphology of the more conspicuous plants, and has seen some of the more important modifications of the different organs, to perform different services to the plant," that the author suggests the use of "a suitable manual of the botany of the region, from which the name and relationships of the species may be obtained." But even after this cautious suggestion of the use of a manual, the author is constrained to say that "the name should not be the end for which the work is done," and "the teacher should prevent this searching out of the name and the practice in the use of the analytical key from absorbing the principal portion of the attention." Thus, although the book is distinctly "phanerogamous," it is as emphatically a laboratory manual, as any of the text-books devoted to the minute anatomy of plants.

The last stronghold of the old time text-book botanists is thus assaulted from an unexpected quarter. Hitherto they have been able to defend themselves with more or less success by crying out against early study by the pupil of small and little known things, as cells, nuclei, green slimes, pond scums, etc. (characterized by one educator as "recondite"), and making a great ado over the difficulty (sometimes asserted to be an impossibility) of supplying the secondary schools with compound microscopes. Professor Setchell has turned flowering plant botany into a laboratory study, and has done so without bringing in anything more recondite than seeds and embryos, or more difficult of purchase than pocket lenses and dissecting needles.

It would be easy to find faults in this book (what book on botany is free from them?) but we feel that it is likely to do so much good in certain quarters that we will say no more than that in our opinion elementary botany should include a good deal about the simpler forms of plants, so that the pupil may obtain some idea of types. It is as good a principle in botany as in mathematics, that we must begin with simple things and proceed to the complex, in order to understand the latter. Then again we know from many years of personal experience, and this not in an old and wealthy community, that the purchase of good compound microscopes (duty free), and the installation of small but efficient laboratories in secondary schools, is as easily accomplished for botany as is the purchase of necessary apparatus and the fitting up of proper laboratories for chemistry. In the new state of Nebraska nearly every accredited high school is now using the compound microscope in the study of plants selected as types of all the greater groups of the vegetable kingdom. We may be permitted to remark, also, that in practice it will be found impossible to secure in nine-tenths of the secondary schools, much of the material suggested by the author for study. In many chapters the teacher may readily make substitutions, but in those relating to epiphytes, parasites, saprophytes and insectivorous plants, this difficulty will prove quite embarrassing.

—CHARLES E. BESSEY.

ZOOLOGY.

The orientation of organisms by light.[1]—The problem that the author undertakes to solve is whether the migration of organisms towards or from a source of light is due to differences in intensity or to the direction of the rays. According to Strasburger, whose views have been more or less generally accepted, the determinant factor is the direction of the rays. His conclusions drawn from experiments with swarm spores of Botrydium and Bayopsis (78) were later (90) confirmed by Loeb in experiments with the larvæ of *Porthesia chrysorrhœa*. But this view of the subject has been opposed by Oltmann (92) as the result of certain experiments performed with *Volvox minor* and *globator*; and Oltman has been supported by Verworn (94).

Davenport and Cannon criticise Oltman's management of his apparatus and themselves attack the problem with what is essentially the method of Strasburger, but use Daphnia instead of plants. A small glass trough was painted dead black inside and out and placed on a table at a distance, at its nearest end, of 51 cm. and of 66.5 cm. at its further end, from the light of a gas lamp having a Welsbach burner which was raised 31 cm. above the table. A wedge shaped box with glass bottom and filled with India ink solution served, when needed, as a screen, the thicker portion of the wedge being placed nearest the source of the rays.

Experiments without the screen showed that the Daphniæ when introduced at the end of the trough farthest from the source of light invariably moved towards the light. When the screen was interposed and all other light than that from the lamp excluded the same result was obtained. They were introduced into the trough at its middle point, still the result was the same. Of 39 individuals introduced at the end of the trough most distant from the light 54 per cent. passed the middle line towards the light, 43 per cent made the entire trip of the length of the trough. Only one of the 39 remained at the starting point.

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[1] C. B. Davenport and W. B. Cannon. On the Determination of the Direction and Rate of movement of organisms by Light. Reprint from Journ. Phys. XXI, 22–32. From Dr. C. B. Davenport.

When introduced at the middle of the trough 57 per cent. of 58 Daphniæ made the entire trip in two minutes. In all 67 per cent. moved towards the light, 12 remained at the starting point and three of these were caught in floating bubbles, 6 individuals, or the remainder, moved away from the light. But these scarcely affect the general result.

From the difference in the distances of the two ends of the trough from the source of the light the authors calculate that the difference in the intensity of the light at the two ends of a Daphnia .1 mm. long exposed to the unobstructed rays is somewhere between .0027 and .0031 of the intensity of the light at one end of its body. But when the screen is used the difference at the thicker end of the wedge will be as great as .0034 of the intensity at one end of the Daphnia and will increase to about 17 per cent. at the edge of the wedge. Consequently, in as much as the decrease in intensity an account of the increasing thickness of the screen is greater than the increase due to greater proximity of the light the authors conclude that the effect of variations in the intensity of the light must be ruled out of court leaving as the only possible cause of the movements of the animals the direction of the light rays. The difference of opinion, it is pointed out, has been due to a failure to distinguish between phototaxis, or the response to the direction of rays, and photopathy, or the response to variations in intensity.

The relation between intensity of light and rapidity of movement.—In the same paper these authors just mentioned endeavor to answer the question, "Do positively phototactic organisms move more rapidly toward their optimum intensity of light than toward an intensity below the optimum?"

The method by which the authors attacked this problem was similar to the one just mentioned. The trough was similarly placed at a horizontal distance of 50 cm. from the burner. In order to guage the intensity of the light an index was attached to the gas cock so that one-fourth and full light could be obtained immediately without the use of a photometer for each experiment. Diffuse light was cut off from the trough by placing this in a second trough with high walls.

The Daphinæ were introduced one at a time at the end of the trough most distant from the light and the time noted when they passed a point 2 cm. from the end of the trough, and again when they passed another point two centimeters distant from the other end. The difference then equalled the time of the trip.

Six series of experiments were performed which were divided into two groups. In the first group there was an alternation from full light to one-fourth light to full light again, and in the second group, from one-fourth to full to one-fourth light.

The distance travelled was 16 cm. The mean times in seconds found in the three series of the first group was 48 (full light), 57, (¼ light), and 31 (full light). In the second group it was 36 (¼ light), 28 (full light), and 30.5 (¼ light). The average time for the full light was 35.7 and for ¼ light 41.2, or expressed as a ratio of the former to the latter the time was 87 : 100.

Sixty trips made in the order of the averages just given in experiments with several individuals changed the ratio to 84 : 100.

The Diaphniæ acted differently when first put in the trough. In full light they started immediately, but in one-fourth light they evinced hesitating movements. This together with the absence of any close relation between the diminished intensity of light and the longer time required for migration in such light than in full light as shown in the averages obtained the authors conclude, and it seems justly, that the longer time required to migrate in the smaller amount of light is due not so much to the lower intensity as to diminished precision in orientation. And this leads to the further conclusion already reached in other experiments that light acts chiefly through the direction of its rays.

The authors' results bear out the conclusions of Nägeli (78) and of Strasburger, who says that the course of swarm spores is straightest in those areas that are brighest, as well as those of Loeb, who asserts that " the orientation of an animal in the direction of the rays is the more precise as the intensity increases."

The table of figures showing the time of the several trips brings out a further fact, namely, that the rate of movement increases with each succeeding trip made by the same animal. The succession averages for full light were 48, 31, and 28 seconds, and those for one-fourth light, 57, 36, and 30.5 seconds. The cause of this increase of speed the authors say they must leave undetermined, but it would seem from common experience that it may have been and probably was due to the animals' experience with the circumstances in which it was placed.—F. C. KENYON.

A List of the Birds of the Vicinity of West Chester, Chester Co., Pennsylvania.—The following list of birds is based upon the observations of a collecting period extending from 1885 to 1891, and again resumed in 1895. By far the greater part of my collecting has been limited to the country within a five miles' radius of the town of West Chester, that is, principally to the higher ground of the townships of West and East Goshen and West Whiteland to the north and east, and to the west and south the valley of the Brandywine Creek in East Bradford townships. All the species here annotated have been shot and identified by myself, with the exception of a few taken by collecting friends; but none are included in this list of which I have not seen specimens in the flesh. For a considerable number of the migratory species I have made notes on the time of their first occurrence in the spring, as well as of the time of arrival of the "bulk" of individuals for the given year, and for some species I have noted the time of arrival or departure in the fall. Many of these dates will be found to correspond very closely with those given by Witmer Stone in his "Birds of Eastern Pennsylvania and New Jersey," 1894. Further, I have endeavored to note the comparative abundance of the species as accurately as possible, and in this point my data would offer approximate correctness, since the area over which I have collected is comparatively limited in extent.

The rarest of the 145 species mentioned below are the following: *Aegialitis semipalmata* Bonap., *Ectopistes migratorius* (Linn.), *Zonotrichia leucophrys* (Forst.), *Lanius ludovicianus* Linn. and *Dendroica caerulea* (Wils.).

1. *Polilymbus podiceps* (Linn.), Pied-billed Grebe. A not infrequent migrant in the fall, along the Brandywine.

2. *Sterna* sp., Tern. I saw an individual of a small species of this genus (perhaps *S. hirundo* Linn.) shot on the Brandywine near Lenape, in the late summer of 1887. Owing to the rapid decomposition of the specimen, I was unable to identify the species.

3. *Anas discors* Linn., Blue-winged Teal. On Aug. 8, 1889, I shot an adult, and at the same time saw another individual, on the Brandywine near Lenape.

4. *Aix sponsa* (Linn.), Wood Duck. An infrequent summer resident on the Brandywine.

5. *Erismatura rubida* (Wils.), Ruddy Duck. I shot an adult female, March 15, 1890, in a marsh by the Brandywine at Lenape.

(In addition to the three species of duck here mentioned, I have seen two or three others, which I was unable to secure and identify.)

6. *Branta canadensis* (Linn.), Canada Goose. This species regularly migrates over our district in the spring, fall and winter.

7. *Botaurus lentiginosos* (Montag.), American Bittern. Rare; I have seen only two individuals, Aug. 3, 1887, and May, 1895, respectively. Both of these I saw very closely, so that there was no possibility of a confusion with the Night Heron.

8. *Ardea herodias* Linn., Great Blue Heron. An infrequent summer resident, becoming rarer each year. I noticed a pair during two summers in East Bradford, and have observed a few in the spring.

9. *A. virescens* Linn., Green Heron. Common summer resident.

(I have never found the Night Heron, *Nycticorax nycticoryx naevius* (Bodd.), in this neighborhood, though I have seen it frequently in adjoining parts of Delaware Co.).

10. *Porzana* sp., Rail. I picked up a badly decomposed specimen of this genus on a country road in late summer—*P. carolina* (Linn.)?

11. *Philohela minor* (Gmel.). American Woodcock. Infrequent migrant during the early spring and late fall.

12. *Gallinago delicata* (Ord.), Wilson's Snipe. A common migrant in the early spring (March 16 to April 25) and late fall, in the marshes along the Brandywine. It is to be found only occasionally in higher localities (West Goshen).

13. *Totanus solitarius* (Wils.), Solitary Sandpiper. This species is a regular migrant in the late spring, when it is often found in flocks of considerable size. Though I have never seen it in the fall, I have shot one specimen and seen others in the summer, so that it is quite probable that it sometimes breeds here.

14. *Bartramia longicauda* (Bechst.), Bartramian Sandpiper. Common summer resident in the higher parts of West Whiteland township, but I have never met with it elsewhere.

15. *Actitis macularia* (Linn.), Spotted Sandpiper. Common summer resident, mainly along the larger streams.

16. *Aegialitis semipalmata* Bonap., Semipalmated Plover. I shot two adult individuals in West Goshen, Sept. 12, 1888. These are, I believe, the only specimens taken in this county.

17. *Ae. vocifera* (Linn.), Killdeer. Common summer resident; arrives in the spring between March 2d and March 16th.

18. *Colinus virginianus* (Linn.), Bob-white. Infrequent resident in this vicinity, though it was more abundant ten years ago.

19. *Bonasa umbellus* (Linn.), Ruffed Grouse. I saw one May 10, 1890, in a thicket, a mile north of West Chester.

20. *Ectopistes migratorius* (Linn.), Passenger Pigeon. I shot one individual of this, now very rare, species, Sept. 1, 1886, in Birmingham township, and a female in West Goshen, Sept. 9, 1887. Both specimens were in immature plumage, and are now in the collection of the Acad. Nat. Sci., Philadelphia. I believe these to have been the last specimens taken in eastern Pennsylvania.

21. *Zenaidura macrura* (Linn.), Mourning Dove. Abundant summer resident. (Earliest arrivals: March 16, 1885; Feb. 22, 1886; March 3, 1887; March 24, 1888; March 14, 1889. Bulk arrived: March 26, 1886; March 30, 1887; March 31, 1888; March 29, 1889).

22. *Cathares aura* (Linn.), Turkey Vulture. Common through the spring, summer and fall; in mild winters a few are to be seen.

23. *Circus hudsonius* (Linn.), Marsh Hawk. Infrequent summer resident.

24. *Accipiter velox* (Wils.), Sharp-shinned Hawk. Infrequent; I have observed it only in the fall, winter and spring.

25. *A. cooperi* (Bonap.), Cooper's Hawk. Rather infrequent resident.

26. *Buteo borealis* (Gmel.), Red-tailed Hawk. Common resident; more abundant than any other hawk.

27. *B. lattisimus* (Wils.), Broad-winged Hawk. I shot an adult male in West Goshen, April 22, 1891.

28. *Falco peregrinus anatum* (Bonap.), Duck Hawk. I saw a specimen in the flesh, shot in East Bradford, Feb. 14, 1886. This specimen is now in the collection of Geo. W. Roberts, Esq., West Chester.

29. *F. columbarius* Linn. My brother shot a male in West Goshen, Oct. 25, 1885.

30. *F. sparvarius* Linn., American Sparrow Hawk. Common resident, though not remaining through severe winters.

31. *Pandion haliæetus carolinensis* (Gmel.), American Osprey. Infrequent; I have noticed a pair on several occasions during the summer of 1888, along the Brandywine (East Bradford). This pair might have been breeding in this vicinity. Is it not probable that many of those seen in this county have crossed over from New Jersey? (Earliest spring date, April 4, 1888).

32. *Asio acciptrinus* (Pall.), Short-eared Owl. A not infrequent visitant in the winter and early spring. I have never seen it in the fall. During some years it is more abundant than in others. I have

met with it on the following occasions: Feb. 17 to April 13, 1888; April 6, 1890; Jan. 8 to March 13, 1891.

33. *Megascops asio* (Linn.), Screech Owl. Common resident.

34. *Nystea nyctea* (Linn.), Snowy Owl. A few are seen or shot every severe winter, and I have seen such specimens in the flesh.

35. *Coccyzus americanus* (Linn.), Yellow-billed Cuckoo. Common summer resident. Arrives about the third week in May.

36. *C. erythrophthalmus* (Wils.), Black-billed Cuckoo. Summer resident, less abundant than the preceding.

37. *Ceryle alcyon* (Linn.), Belted Kingfisher. Common summer resident, remaining until about December. Arrives in the spring between March 15 and April 6.

38. *Dryobates villosus* (Linn.), Hairy Woodpecker. Infrequent in the fall, winter and early spring. I have never observed more than three or four in any one year. (Earliest fall occurrence: Sept. 10, 1887; latest spring occurrence: April 14, 1889).

39. *D. pubescens* (Linn.), Downy Woodpecker. Common resident.

40. *Sphyrapicus varius* (Linn.), Yellow-bellied Sapsucker. Rather common, though somewhat irregular, migrant in the spring (April) and fall (Sept. 28 to Nov. 21).

41. *Melanerpes erythrocephalus* (Linn.), Red-headed Woodpecker. Common summer resident, especially in the valley of the Brandywine; much less abundant on higher ground. (Earliest arrivals: March 11, 1886; April 28, 1891).

42. *Colaptes auratus* (Linn.), Flicker. Common summer resident, the most abundant representative of the family, with the possible exception of the Downy Woodpecker. (Earliest spring arrivals: March 7, 1886; March 23, 1887; March 24, 1888; March 27, 1889. Bulk arrived: April 3, 1886; April 10, 1887; March 31, 1888; March 31, 1889; April 15, 1891). One was seen by me Dec. 22, 1885.

43. *Antrostomus vociferus* (Wils.), Whip-poor-will. I heard one very plainly on April 27, 1891, in West Goshen township.

44. *Chordeiles virginianus* (Gmel.), Nighthawk. Rather common summer resident in certain dry and rocky localities, as, e. g., the "Barrens" in West Goshen. (Earliest spring arrivals: March 15, 1886; May 3, 1887; May 9, 1888; May 3, 1890. Bulk arrived: May 11, 1886; May 19, 1887. Remains in the fall until nearly October).

45. *Chaetura pelagica* (Linn.), Chimney Swift. Abundant summer resident. (Earliest spring arrivals: April 16, 1887; April 7, 1888; April 19, 1889: April 13, 1891. Bulk arrived: April 24, 1886; April 30, 1887; April 25, 1891. Leaves in the fall before Oct. 10).

46. *Trochilus colubris* Linn., Ruby-throated Humming-bird. Rather common summer resident. (Earliest spring arrivals: April 14, 1886; May 9, 1887; May 17, 1888; May 2, 1897).

47. *Tyrannus tyrannus* (Linn.), Kingbird. Common summer resident. (Earliest spring arrivals: April 2, 1885; April 7, 1886; May 4, 1887. Bulk arrived: May 5, 1887; May 9, 1888).

48. *Myiarchus crinitus* (Linn.), Crested Flycatcher. Common summer resident, though not as abundant as the preceding. (Earliest spring arrival: May 3, 1890. Bulk arrived: May 7, 1887).

49. *Sayornis phoebe* (Lath.), Pewee. Abundant summer resident. It arrives in the spring much earlier than the other flycatchers. (Earliest spring arrivals: March 29, 1886; March 27, 1887; March 23, 1889; March 16, 1890; April 8, 1891; March 23, 1895. Bulk arrived: April 3, 1886; April 21, 1887).

50. *Contopus virens* (Linn.), Wood Pewee. Abundant summer resident, more numerous than the preceding species. (Earliest spring arrivals: April 17, 1886; April 28, 1891. Bulk arrived: May 7, 1887).

51. *Empidonax flaviventris* Baird, Yellow-bellied Flycatcher. Infrequent if not rare migrant in the fall. I have secured only three or four specimens, but have seen others in the collections of local ornithologists.

52. *E. virescens* (Vieill), Acadian Flycatcher. An infrequent migrant in the spring.

53. *E. minimus* Baird, Least Flycatcher. Infrequent migrant. I shot three specimens and saw another in the month of May (1890, 1891), but have never seen it in the fall.

54. *Cyanocitta cristata* (Linn.), Blue Jay. Common resident in thick woods along the Brandywine, less frequent in higher localities. In the winter it is also found in the open country.

55. *Corvus americanus* Aud., American Crow. Abundant resident, though some appear to migrate in severe winters.

56. *Dolichonyx oryzivorus* (Linn.), Bobolink. Common, occasionally even abundant, migrant in the spring and fall. In the former season it is found almost exclusively along the Brandywine, but in the fall is frequently met with also in the uplands, in clover fields. (I have the following notes on its occurrence. Spring: May 11–20, 1896; May 5–17, 1887; fall: Aug. 4–29, 1886; Aug. 8, 1889; Sept. 25, 1890).

57. *Molothrus ater* (Bodd.), Cowbird. Abundant summer resident. (Earliest spring arrivals: March 13, 1887; March 14, 1889; March 15, 1891. Bulk arrived: March 24, 1887; April 4, 1888; March 23, 1889).

58. *Agelaius phœniceus* (Linn.), Red-winged Blackbird. Abundant summer resident. (Earliest spring arrivals: March 8, 1887; February 22, 1888; March 12, 1889. Bulk arrived: March 13, 1887; March 17, 1888; March 23, 1889).

59. *Sturnella magna* (Linn.), Meadow Lark. Abundant resident. During mild winters large numbers may be found in sheltered valleys, while in severe winters, as was 1895, few are to be seen. I can corroborate the fact noticed by other observers that this species in the cold season always migrates, to a certain extent, by leaving the higher ground to collect in the valleys.

60. *Icterus spurius* (Linn.), Orchard Oriole. Rather common summer resident, but less abundant than the following species. (Earliest spring arrivals: May 4, 1887; May 3, 1890. Bulk arrived: May 7, 1886; May 5, 1887; May 6, 1888).

61. *I. galbula* (Linn.), Baltimore Oriole. Common summer resident. (Earliest spring arrivals: May 5, 1886; May 1, 1887; April 29, 1888; May 9, 1891. Bulk arrived: May 7, 1886; May 4, 1887).

62. *Scolecophagus carolinus* (Müll.), Rusty Blackbird. Saw a single individual, Nov. 22, 1896.

63. *Quiscalus quiscula* (Linn.), Purple Grackle. Abundant summer resident. (Earliest spring arrivals: Jan. 2, Feb. 10, 1887; Feb. 20, 1888; March 2, 1889; Jan. 29, 1890; Feb. 2, 1891. Bulk arrived: March 8, 1887; Feb. 26, 1888; March 1, 1890; Feb. 24, 1891. Latest occurrences in the fall: Nov. 25, 1887; Dec. 20, 1889).

64. *Q. quiscula æneus* (Ridgw.), Bronzed Grackle. I have a single specimen in my collection, taken in East Bradford, April 30, 1889.

65. *Carpodacus purpureus* (Gmel.), Purple Finch. I have personally observed this bird only in the year 1887, when I saw a number of small flocks from April 26th to May 9th. According to West Chester papers, they were observed also in the following spring. It would seem to be an irregular spring migrant in this locality.

66. *Loxia curvirostra minor* (Brehm.), American Crossbill. Infrequent winter resident. I have found it on only two occasions, but Mr. Josiah Hoopes has collected it quite frequently in the Hoopes' Nurseries, West Goshen.

67. *Acanthis linaria* (Linn.), Redpoll. Irregular visitant in exceptionally cold winters. I have seen it only once, on March 24, 1888, when I noticed a flock of about a dozen.

68. *Spinus tristis* (Linn.), American Goldfinch. Abundant resident, though large numbers migrate in severe winters.

69. *S. pinus* (Wils.), Pine Siskin. Irregular winter visitant. I have seen it twice, a single individual, on Feb. 5, 1888, and a small flock on

the 22d of the same month. I also noticed a flock of about 30 in our apple orchard, from April 28 to May 7, 1897, and shot several individuals.

70. *Poocaetes gramineus* (Gmel.), Vesper Sparrow. Abundant summer resident. (Earliest spring arrivals: April 5, 1887; March 31, 1888; March 28, 1889; April 13, 1891; March 29, 1895. Bulk arrived: April 6, 1887; April 1, 1888; April 4, 1889; April 19, 1890).

71. *Ammodramus sandvichensis savanna* (Wils.), Savanna Sparrow. Abundant migrant in the spring and fall. (Spring occurrences noted: April 8–13, 1886, March 28, 1889; April 19, 1890; April 18 to May 9, 1891).

(*To be continued.*)

On the Use of the Terms Heredity and Variability.—Recent discussions of various biologic phases of evolution have become so refined that our attention must be more critically given to the exact meaning which each writer gives to the terms he uses. Each author, having some special point to emphasize, gives his own particular definition to common terms, and so makes a direct comparison of his propositions with those of other writers impossible. A great deal of time-patience-consuming controversy finds room in mere quibbles of words without essential disagreement of ideas. Even the terms "heredity" and "variability," standing for the very foundation blocks of evolution, suffer seriously from this duplicity of definition.

It has long seemed to the present writer that considerable polemic friction could be avoided without a re-definition of these two important terms if the relationship of the two notions were more accurately and generally apprehended. Heredity and variability are so commonly placed in antithesis that we unconsciously assume that they express qualitative differences. But they do not. In relation to each other their significance is purely quantitive. In the quantitive scale they designate supplements. If one race manifests variability more than another it manifests heredity by so much less. If variability increases in a variety heredity wanes. If the inheritance of likenesses becomes more marked we say that variation is growing less; our variety is becoming "fixed." Thus heredity and variability really stand to each other as heat and cold,—as positive and negative. And a perfectly accurate nomenclature could dispense with one or the other. But while both terms are still conveniently retained, as are the terms heat and cold, it is extremely desirable that their unity of application be observed.

If this complimentary nature of heredity and variability were more keenly appreciated many evolutionary misunderstandings would be forestalled at their very beginnings. Thus it has been usual for philosophers, like Lamarck, Nägeli and Eimer, to assume that the exact reproduction of likeness was the original characteristic of organic reproduction, and that variability is an anomaly to be accounted for. This is now met by Bailey's contra-assumption that unlikeness marks all unsophisticated reproduction, and that "heredity is an acquired character." Both are equally assumptions and equally gratuitous. What we actually *know* is that among different races the average degree of likeness between successive generations differs. We also know that the degree of likeness fluctuates from generation to generation in the same race. We do not know of such a thing as absolute likeness, nor do we know the complete absence of heredity. The only thing that we do know is that similarity begets similarity. That like begets like, or unlike begets unlike can be true only by a quibble of the terms.

In dealing with this subject in a very critical class of students we have so much felt the need of more precise nomenclature that I have given the name of the allophysical law to the formula "similarity begets similarity." Heredity is then retained in its absolute sense (the sense in which it is actually most used) as a convenient zero-point from which to measure variability. But the normal cause of reproduction is not conceived to be the repetition of exact likenesses, nor of total unlikenesses, but is understood to follow the allophysical law.—F. A. WAUGH.

Zoological News.—According to Mr. E. H. L. Schwartz, Spirula is in its anatomy closely related to Sepia. As to its descent the author finds that it has been derived from the Belemnites through Spirulirostra, thus reversing the process set forth in an authoritative article recently published. Mr. Schwartz bases his conclusions upon the study of sections of the shell passing through all the whorls in the plane of coiling, whereby the structure of the walls and septa are well exposed. (Journ. Marine Zool. and Micros., Vol. II, No. 6.)

Nineteen species and subspecies of Voles are recognized by Mr. Bailey as inhabiting Canada and the United States. Of these, five are described as new. Concerning the habits of these animals the author states that they do not hibernate in winter, nor has he ever found evidence of their storing provision. They make long tunnels under the snow, through which they travel about in safety while they procure the tender grass blades and ripe seeds as easily from the surface of the ground as when the white blanket is not above them. (Proceeds. Biol. Soc. Washington, Vol. XI, 1897.)

A late number of the Proceeds. Phila. Acad. contains an anatomical description of *Tarsius fuscus*, by Dr. Harrison Allen. The author describes the superficies, auricles, rugæ, bones and muscles and compares them with the account of the corresponding parts in the allied species *Tarsius tarsius* as given in Burmeister's monograph. Dr. Allen goes into some detail which is lacking in Burmeister's paper, notably full descriptions of the teeth, with figures; and notes on the mechanism of the limbs. (Proceeds., Phila., Acad., 1897.)

ENTOMOLOGY.[1]

Miss Ormerod's Report.—A perusal of Miss Ormerod's recent report on the injurious insects of Great Britain for 1896, shows that the insect pests on the other side of the Atlantic differ but little from their cousins here in their methods of attack. In fact, in many instances they are identical, portions of the report treating of the codlin moth (*Carpocapsa pomonella*), Asparagus beetle (*Crioceris asparagi*) and several other only too common American insects. There are numerous injurious insects, however, at present confined to the Old World, many of which in time are likely to gain foothold here, and against the introduction of which we cannot be too careful. Notice the devastation wrought by the common cabbage butterfly (*Pieris rapœ*) which in a few years after its introduction had spread from the Atlantic to the Pacific, and yet in England it is usually considered as of minor importance compared with its larger relative *Pieris brassicœ.* The gypsy moth is another example of the alarming spread of an insect in a new country when unchecked by its natural enemies. Hundreds of thousands of dollars have been spent by Massachusetts in an endeavor to eradicate it after it had gotten a strong foothold, all of which might have been saved had the attempt been made in time. And now according to the newspapers another undesirable emigrant has arrived on the scene in the form of the "brown tailed moth" and established itself in the very midst of the gypsy moth infested region in a strip a "mile long by half a mile wide" in which it has "stripped the most of the fruit and many of the shade trees." The insect from its life history would seem to be an easy enemy to fight and should it be as dangerous as reported will probably be stamped out with little trouble unless it has a greater range than was supposed. But if the few people who noticed it in previous years had but had a knowledge of entomology, who knows what might have been saved.

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[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

The Twentieth Report shows the same painstaking care in its preparation that have characterized its predecessors. It has as a frontispiece a half-tone portrait of the author's sister, Miss Georgiana E. Ormerod, who so long collaborated in the entomological work, and who died during the year. American entomologists generally have felt much sympathy for Miss Ormerod in this loss and will read with interest the touching tribute in this report.

A large number of insects are treated of by the author of the report, and several new illustrations embellish its pages.

Lepidoptera.—Under the names Ptilodontidæ and Melalophidæ, Mr. Harrison G. Dyar[2] has made a generic revision of the North American, European and Indian members of that group of moths until recently known as Notodontidæ. He separates the two groups or families on larval characters. The lowest genera (*e. g.*, Gluphisia) present "smooth larva with simple setæ; others have variously humped or otherwise modified bodies. Then follows a group in which the moths tend to lose the tongue although not sharply marked off by this character. The larvae, however, are hairy, that is they have developed warts and secondary hairs. The wart formation is peculiar being characterized by three warts above the stigmatical wart on the thorax, and thus contrasting with the parallel wart formation in the Arctiid allies, another great branch of the Bombyces. At first all the warts are in line but soon we reach forms (*e. g.*, *Apatelodes*) in which the central wart is moved back out of line. At this point a large group of moths in India, has diverged from the type losing one vein of the fore wings. These are the true Eupterotidæ and form the highest group of the Ptilodont allies. The line is, however, almost directly continued by the European genus Lemonia (frenulum gone) into the Lachneidæ (cubitus 4-branched), the larva remaining true to type but becoming gradually more specialized to culminate in the Lachneids." The Eupterotidæ are not treated of in the revision. As may be seen the first division is much the larger, but the second contains such well known forms as Datana, Melalopha (Ichthyura) and Apatelodes.

McNeill on Tryxalinæ.—The Davenport Academy of Natural Sciences, has just published in an octavo pamphlet of 96 pages and six admirable plates, Prof. J. McNeill's Revision of the Tryxalinæ of North

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[2] Transactions of American Entomological Society, XXIV, 1–20.

America. It is one of the most important pieces of recent work done on the North American Orthoptera by American entomologists; for the Tryxalinæ have been one of the least known though richest groups. The classification is an independent one and does not follow very closely Brunner's general outline of the Tryxalinæ of the world given four years ago, and which contains a relatively small proportion of the genera recognized by McNeill. Altogether 75 species are entered, referred to 31 genera of which 11 are proposed as new. Only ten new forms are described which is an astonishingly small number for the country since several new forms have been found in the East within recent years and a great deal remains to be done even here. A full figure, generally with considerable additional detail, is given for each genus, but unfortunately the enlargement above nature is not indicated. This memoir places our small grasshoppers on a very different basis from that on which they stood before and the figures alone are a striking addition to our means of study and determination.—*Psyche*, Vol. VIII, No. 352.

John L. Curtis.—Mr. John L. Kellogg in the Entomological News for April, 1897, in a sketch of the life of John L. Curtis says:— "The name of Mr. Curtis is not familiar to entomologists but I wish that some particulars of the brave life of this student of entomology, may be known to those whose attention may be arrested by the unknown name.

"John L. Curtis, of Oakland, Cal., died at twenty-five. During the twelve years preceding his death, his waking hours were passed in a wheeled chair. A paralytic affliction deprived him of the use of the muscles of body, legs and arms except those of his wrists and hands. His consolation and delight were found in the study of Natural history. After caring for and watching a solitary spider kept in confinement for several years, he began with earnest zeal the careful study of spiders. His friends sent them to him in such numbers that at times, he had sixty or seventy species under observation. Wheeled by a companion along hedge-rows he observed them in their natural homes and collected them. After three years of delighting, absorbing study his eyes so failed him, that he was limited during two years to one half hour a day to microscopic or minute examination. In the last two years of his life, his health failing constantly, he devoted himself exclusively to the observation of the new spider described elsewhere in the News. He devised ingenious methods of feeding, housing and watering his spiders. He made exhaustive observations of their every habit and recorded all in notes and drawing. Untrained, inert, helpless, tortured, his patient enthusiastic devotion to his studies, has enabled him to add something to our knowledge of living things and to find for himself happiness in the midst of affliction."

The description of the new spider is given in the same number and the substance of part of the author's notes in the species. Probably no species of insect has ever been described with such copious notes as to its life history and habits as in this case.

Hemiptera.—Mr. B. M. Duggar[3] has made a study of a bacterial disease of the Squash bug (*Anasa tristis*), and publishes a series of experiments on the inoculation of other insects with the culture.

The toxic properties of the bacillus were very marked. From one of the early isolation cultures several colonies of the disease bacteria were removed, "and diffused in a small quantity of distilled water to serve some inoculation purposes. On immersing young squash bugs in this solution death followed almost instantly.

With nymphs somewhat older the effect was not so rapid but the bugs soon succumbed. Young chinch bugs, flies and other insects stiffened as if dead on being immersed from one to several minutes. Many of the hard shelled insects if removed immediately on becoming rigid recover in a few minutes sufficiently to crawl away; but even these die if immersed in the solution for a longer time."

Messrs. Herbert Osborn and E. D. Ball[4] have published the results of a study of the life histories of the grass feeding Jassidæ. The more general results of their investigations show that so far as known all species deposit eggs upon the stem under the leaf sheaths of the plants used as food, and that the species have as a rule decided limitation as to food plant, but that the adults are more general feeders. Some of the species have but one brood, others two and still others three in a season and the ordinary life of a brood does not exceed two months. Some twenty-four species are noted as injurious to grass, several of which are undescribed. Technical descriptions of hitherto undescribed forms will appear in a forth-coming paper in the Proceedings of the Iowa Academy of Natural Sciences.

Mr. J. B. Smith[5] has made notes on the life history of the harlequin cabbage bug and melon plant louse (*Margantia histrionica* and *Aphis gossypii*) with preventive and remedial measures.

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[3] Bull. Ill. State Lab. of Nat. History, IV, 340–379.

[4] Bull. 34, Iowa Agri. Expt. Station.

[5] New Jersey, Agri. Exp. Sta., Bull., 121.

Alternation of Generations in Cynips calicis.—A recent paper by Prof. M. W. Beijerinck in *Archives néerlandaises d. sci. ex. e. nat.* (tome XXX, livr. 5) brings to light a very interesting case of alternation of generations in the genus Cynips as restricted by Mayr. *Cynips calicis* is a large agamic gall fly, produced from a rather large irregular gall on the acorns of *Quercus pedunculata.* This gall is rich in gallic acid and is of commercial importance in parts of southeastern Europe. In begins to develop in May, falls to the ground in autumn, and does not decay for several years. A portion of the flies come out at the end of the first winter and the remainder at the end of the second winter. The fly which emerges from this gall is incapable of producing it. The eggs of *Cynips calicis* are not deposited on *Quercus pedunculata* at all, but on another species of oak, *Quercus cerris.* *Cynips calicis* emerges in March and at this time the acorns of *Q. pedunculata* do not exist even in embryo, and are not in condition for eggs to be deposited in them until fully two months later. The eggs of *Cynips calicis* are deposited in the young anthers of *Quercus cerris* and from this oviposition results a conical tiny, hasty gall, very easily overlooked. Out of these galls in about two months emerge tiny, smooth gall flies, male and female, which belong to the genus Andricus. These flies immediately pair and the females at once deposit their eggs on the now ready young acorns of *Quercus pedunculata*, and around these develop the large galls of the *Cynips calicis.* The author was led to these discoveries by the fact that *Q. pedunculata* bears no galls of *Cynips calicis* in the Netherlands except when an occasional tree of *Q. cerris* happens to have been planted in the vicinity of the other species. His observations and experiments cover a period of several years, and there seems to be no doubt of his having proved his points. It is suggested that the galls of *Cynips calicis* might be made commercially important in the Netherlands by generally planting *Q. cerris* in the groves of *Q. pedunculata.* Of course, the thought lies very near that other species of Andricus simply represent the sexual stage of species of Cynips.—Erwin F. Smith.

General Notes.—Mr. F. H. Chittenden[6] has prepared a collection of articles on little known insects affecting stored vegetable products. Notes are given on a number of insects, some of which are previously unrecorded from America, and may prove decidedly injurious in the future.

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[6] U. S. Dept. of Agri., Div. of Entomology, Bull., No. 8—New Series.

Mr. Claude Fuller[7] of the Technological Museum, Sydney, has described and figured a very peculiar gall from a common Australian plant, which bears a striking resemblance to a caterpillar with its head and anterior parts of its body thrown back in an "attitude of defense." Neither "beetles nor inquilines seeking a suitable rearing ground for their young would be attracted by a caterpillar," thus protecting the inhabitants from injury from that source and though "insectivorous and predaceous birds might be attracted by it, they would at once be repelled by its woodiness while small wood pecking species, which might prey on its inhabitants would seldom be attracted by its appearance."

Dr. Otto Lugger[8] has prepared an extended report of the insects injurious in 1896, and of the parasites of man and the domestic animals.

EMBRYOLOGY.[1]

Breeding Habits of the Spotted Salamander.—The instincts and habits connected with the process of fertilization in the tailed amphibia are so remarkable, that even a few imperfect observations on these processes in our common salamander (*Amblystoma punctatum*) seem worth recording in the hope of aiding in some future comparative study that may throw light upon this puzzling chapter in Natural History.

Since Gasco[2] and Zeller[3] showed that the European triton and several other salamanders have an internal fertilization and yet no copulation, Jordan,[4] and also Gage,[5] have described much the same series of events in our common newt (*Diemyctylus viridescens*), while Ritter[6] has recently found similar phenomena in the western newt (*D. torosus*).

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[7] Agricultural Gazette of New South Wales, VII, 697.

[8] Minnesota, Agr. Exp. Sta., Bull. 48.

[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Gli amori del tritone alpestre, Geneva, 1880, and Les amours des Axolotyls. Zool. Anz., IV, 1881.

[3] Ueber die Befruchtung bei den Urodelen. Zeit. f. wiss. Zool., 1890, XLIX.

[4] Spermatophores of Diemyctylus. Journal of Morphology, V, 1891; and Habits and Development of the Newt. Idem., VIII, 1893.

[5] Life History of the Vermillion-spotted Newt. AMER. NAT., Dec., 1891.

[6] Diemyctylus torosu. Proc. Cal. Acad. Nat. Sci. Zool., Vol. 1, Jan. 18, 1897.

From the excellent and detailed accounts given by Jordan we learn that during great sexual excitement the male clasps the female firmly for a long time; then the animals separate and a remarkable procession follows, the male going in advance deposits sperm in special cases, spermatophores, which are taken up by the female and subsequently used in fertilizing the eggs before they are laid, that is, the sexual embrace does not lead to transfer of sperm directly, but to subsequent deposition of spermatophores that are gathered up by the female. These spermatophores are small gelatinous masses containing sperm, and are taken into the cloaca of the female as she walks over them.

Apparently much the same series of events takes place in the breeding of Amblystoma. About Baltimore the eggs of this large salamander are very abundant in March and even in February in small pools in the woods, but the adults are then rarely seen. Since 1878 and '79 when F. S. Clarke[7] succeeded in obtaining a male and a female and saw the eggs deposited in captivity, the adults have very rarely been taken at the breeding season. Even when small pools, but four feet wide and nine inches deep, were thoroughly raked out before and after the eggs appeared, no adults were found, so that it was inferred that the laying takes place in the night and that the adults may even leave the water every day to conceal themselves under stones, etc. But this spring Mr. M. T. Sudler found a female moving away from a bunch of eggs early in the morning. This specimen kept isolated laid many eggs, and as these developed into normal larvæ, the existence of internal fertilization was proven.

In these small pools the laying of amblystoma eggs was preceded by 24 hours or so, last year and this, by the occurrence of white specks formed in lines on the dead twigs and leaves covering the bottom. These objects were quite conspicuous when the water was clear, and were at first thought to be some fungus growths from dead twigs, but on examination proved to be gelatinous pyramids or irregular cones of clear material bearing globoid, opaque, white enlargements at the tips. Each was about one half an inch high and firmly attached to a dead twig or leaf, generally at the edge of the latter as might be the case if put down from the clasping lips of the cloaca of Amblystoma. Distributed at intervals of a few inches they formed lines of several to a dozen. Microscopic examination showed the opaque tips to be a mass of coiled, densely packed filaments, highly refracting and at first sight apparently with no ends, yet appropriate stains differentiated the essential parts of spermatozoa and showed that these threads might well be the very large sperms of Amblystoma, seen and measured by S. F. Clarke. These masses thus agree essentially with the spermatophores of other tailless amphibia; they are more slender and higher than those of Diemyctylus, but built on the same general plan, and much less complex in form than those of the European triton.

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[7] The Development of *Amblystoma punctatum*. Studies Biol. Lab. J. H. U., Vol. I, Baltimore, 1879.

Though it is most probable that these bodies are the spermatophores deposited by the male Amblystoma before the female lays the eggs, yet it is, perhaps, possible that they may yet prove to be but preliminary attempts at egg laying; the female depositing some sperm within such secretion as is normally formed about the eggs. But this latter assumption seems scarcely tenable.

We may conclude: (1). Fertilization in *Amblystoma punctatum* is internal (at least in the case observed). (2). Sperm-containing masses are often deposited before the eggs are laid; these are probably spermatophores put down by the male. (3). We may infer that the female gathers up the sperm from some of the spermatophores and that through this act the eggs are fertilized.—E. A. ANDREWS.

Cell Division and Nuclear Division.—Boveri[8] has repeated his notable attempts to fertilize non-nucleated pieces of the eggs of one species of sea-urchin (*Echinus tuberculatus*) with the sperm of another (*Strongylocentrotus lividus*) and finds incidentally some remarkable illustrations of the independence of nucleus and centrosome, and of the connection between the nucleus and cell division.

In most cases where only one sperm enters such a non-nucleated piece of egg of another species the first cell division results in forming two masses—one with all the nuclear matter of the sperm the other with one centrosome and no nuclear matter. The mass with the nucleus continues to divide and forms a small blastula that may live three days. The other does not divide but remains as a single mass adjacent to the dividing cell; inside it, however, the centrosome does divide and with the *same rhythm* as in the first mass, so that there are ultimately a large number of centrosomes and stars in a single cell or non-nucleated, undivided mass.

In fact the centrosomes go through all the phases they would in cell division, though the nucleus is absent!

Various facts and considerations lead the author to think it likely that the mitotic phenomena are started by conditions of the protoplasm that affect both the centrosome and the nucleus and lead them to go through their characteristic changes, independently of one another.

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[8] Ph. Med. Verein, Wurzburg. Oct., 1896.

From the behavior of eggs that are entered by two or more sperms the author concludes that cell division does not take place without nuclear division. In these cases, at least, the egg divides into two, or into four cells or *partly* divides according as the asters have a nuclear spindle between them or not.

Moreover it is not the mere presence of the nucleus that is necessary for cell division but the nucleus must be connected with the centrosomes.

Visible Complexity of Protoplasm in Certain Eggs.—The great advances which have been made since the days when the nucleus of an egg was spoken of as a mere vesicle with one or more "spots" in it are well illustrated by the elaborate study made by the Abbé Carnoy[9] with assistance of H. Lebrun.

With remarkable patience, skill and trained imagination M. Carnoy has unraveled the complexities of structures seen in many thousands of sections of the eggs of certain salamanders and gained by ten years of labor a coherent conception of the successive changes these eggs undergo. The beautifully executed drawings that accompany the memoir show most remarkable arrangement of "chromatin" or staining material within the nucleus; the nucleus appears as a sphere of most complex and changeable structure—even the "spots" or nuclei within it having more complexity of structure than can be seen in many whole nuclei.

The paper describes the appearance of the egg nucleus at successive stages while it is growing ripe in the ovary. Chiefly *Salamandra maculosa* Laur. and *Pleurodeles Waltlii* Mich. served for material.

In the former, fertilization takes place about the first of July; the young are born alive the following Spring and leave the water towards September. The eggs in these young are about 200μ in diameter with a nucleus 110μ the end of the following May. The second May the eggs are 500–600μ and the third May, 1400. Not till the end of June, of the following year are they ready for fertilization; then they are 3500–3700μ. The eggs then require more than three years to develop and the females are about five years old when first ready for copulation.

As the egg enlarges during about three years the nucleus exhibits the successive changes described in outline below.

In the young ovarian eggs 30μ in diameter the large nucleus (18μ) contains a conspicuous filament of chromatin, which appears as a closed loop with no free ends. Besides this the nuclear sap is also resolvable into a very fine network of plastin (linin of some). This chromatic filament breaks up and parts of it remain as *nucleoli*. The nucleoli are thus all chromatic and not plasmatic in origin.

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[9] La Cellule XII. Feb. 1, 1897, pps. 191–292, pls. 6.

It is subsequent changes in these nucleoli that constitute the remarkable, complex figures seen in the numerous illustrations.

The part of the original nuclear filament not concerned in forming nucleoli becomes *resolved* into innumerable minute granules. These granules arise from the filament in various ways somewhat as do similar granules from the nucleoli, as described below. The granules disperse in the nuclear sap, but not without reference to the pre-existing structure of that sap, in fact they seem to travel out along the strands of the plasmatic network. Ultimately these granules dissolve and the filament is henceforth represented only by the nucleoli.

We come thus to a stage in which the nucleus contains no visible objects except the chromatic nucleoli and the fine plasma net. The nucleoli, as they formed from the filament, went out to the periphery of the nucleus to lie near its membrane. They next begin a migration inwards towards the central part of the nucleus and enlarging become *resolved* into remarkable figures. These figures are different in successive years and even in different animals and much of the labor of the authors has been the attempt to arrange the large mass of material in some classified order.

These figures continue to be found all through the growth of the egg; *successive generations of nucleoli arise and are resolved into figures.*

Many of the figures would be taken for arrangements of chromatin directly arising from the original loop—others seems strange and bizarre.

Any continuity of chromatin seems here out of question, except as the nucleoli first arise from chromatin and subsequently are continued as successive generations of chromatic figures; any attempt to trace continues chromatic bodies, chromosomes—seems most impossible.

We cannot attempt in the limit of a short abstract to mention the numerous shapes the nucleoli assume in the process of resolution. Starting from the form of a spheroidal, apparently homogeneous body the nucleolus may swell up into a spongy mass that transforms into a large network of complex strands, each composed of innumerable granules. Or the nucleolus may branch out into plume and brush-like figures, often resembling a test-tube-or lamp-chimney-cleaner. Other nuclei form branching trees, coiled filaments, groups of balls with filamentous connections, stars and radiating masses looking like spattered paint.

Some of the figures are found only at certain periods of the year others in various stages of the development of the egg; some periods are characterized by the occurrence of only one form of figures while others have a prevailing form and others a mixture of many forms.

The time taken to form the figures cannot be determined, but apparently the various generations of nucleoli follow rapidly, each being resolved into the figures and the figures forming granules and the granules dissolving into the material that presumably dissolves away into the cell protoplasm to help form the yolk.

The successive generations of nucleoli arise from preceeding ones; the first nucleoli come as stated above from the original chromatic filament, the following generations arise from the *granules*, into which the nucleoli disintegrate—some granules not dissolving but persisting; later some nucleoli arise from *spherules* or larger fragments of figures that do not break down into the minute granules. In either case the new nucleoli arise near the nucleolar membrane; in the first case from many granules that become enveloped by a membrane in the second case by the union of several spherules or else by the enlargement of a single spherule.

Now the granules are arranged along the plastin network and when many combine to form a new nucleolus that nucleolus is a structured and complex body having in it a network with granules and an outside membrane. Though the nucleolus looks homogeneous yet actual sections of nucleoli may show the outside membrane, the plastin network and the granules or filaments of chromatin: in *fact the nucleolus has the same structure as the nucleus.* This is seen in section and again when the nucleolus passes into the interior of the nucleus to be resolved into some complex figure; it may then even come out of its membrane and, as it were, grow out in a tree like net with chromatin on the meshes.

Before speaking of the interesting descriptions of the formation of yolk, outside the nucleus, we may venture to restate the above brief outline of the process of resolution of nucleoli in comparing it with a complex series of pyrotechnic displays. The nucleoli are like most complicated fireworks arranged about the periphery of the nucleus—apparently simple but complex in internal arrangement. They move inwards towards the centre of the nucleus—as if discharged and then unfold the most diverse stars, feathers, coils, nets, etc., that ultimately burst into the smallest sparks, granules, scattering outwards through the nucleus along the network of plastin that fills the entire area. When most of these sparks are quenched some few are coming together near the old point of discharge and fashioning a complex rocket, Roman candle, or wheel that will in turn be set off at the succeeding display of figures—and so on for several years.

Thus innumerable granules are formed and dissolved, few keeping intact to form the next generation. One result of the great manufacture of granules is, the author conceives, the formation of yolk in the egg.

The yolk begins to appear when the egg is only 300μ in diameter and grows to be the large mass of crystal-like bodies familiar in the eggs of Amphibia. The first perceived change in the egg protoplasm is the occurrence of minute areas near the cell periphery; areas which include a considerable number of the spaces of the plastin network and become recognizable from the rest of the network by a difference in refraction, looking as if the spaces of the net were filled in by solid albumen. Such changed areas ultimately fuse together to form a zone in peripheral part of the egg and as the yolk increases this zone extends in toward the nucleus, more and more. In one of the small areas there appear exceedingly minute granules along the lines of the net—these are the young yolk granules that enlarge as if small crystals growing in a solution. This solution is thought to be furnished by the combined activity of nucleus and egg protoplasm; the nucleus furnishing paranucleic acid and the egg protoplasms the globulins; these combining make paranuclein and then vitilline—the yolk granule. The generations of figures in the nucleus form granules of nuclein that dissolve and by hydrolosis the nucleic acid is set free—this becomes the paranucleic acid that is supposed to soak out through the cell to the region where yolk is to form. However this may be, the granules of yolk enlarge and appear scattered in stout strands or cords of protoplasm that run amongst vacules or water spaces in the egg. Hitherto there have been no vacules in the egg and the author denies that there is anything comparable to the foam-structure of Büschli; the vacules that now appear are, he thinks, due to the absorbtion of water by the globulins. The vacules may become large and be subdivided by strands of protoplasm going across them. The water thus collected is later seen in deeper parts of the egg towards the nucleus and the egg thus takes on a *spongy* structure as the yolk develops. The minute yolk granules move centrally from this first place of origins in the strands amidst the vacules and now get into the spongy protoplasm; here each one may get into a watery vacule and grow to its definition size and form. The yolk granules thus start in the plastic net and end in a vacule; how this change is brought about is not evident from the author's account.

The interesting introductory statement and the author's views upon the centrosome question cannot be reviewed here as they do not bear directly upon the present subject.

PSYCHOLOGY.[1]

Rapid Calculators.—In 1894 Prof. Binet published an elaborate series of tests made on two well-known "lightning calculators," Diamandi, a Greek, and Inaudi, an Italian. A notable result of these tests was to show that while one of the pair, Diamandi, was of a visual type, like most professional calculators, the other, Inaudi, was exceptional in being auditory. Thus while the former committed numbers to memory more readily when they were written out, and was able to repeat a square of figures, once memorized, by rows or columns with equal facility, the latter learned numbers more rapidly when they were given orally, or by speaking them himself, and found it difficult to repeat them afterwards in any other order than that in which he had committed them. Inaudi always accompanied his calculations by slight lip and throat movements, and when asked to make a constant and uniform sound during his work, declared himself wholly unable to perform the required operations.

These observations have recently been supplemented by a monograph study by Sign. Guicciardi and Ferrari[2] of an Italian, Ugo Zaneboni, who has lately been giving exhibitions of his skill as a calculator. They found him to be visual in type, like Diamandi, with whom, however, he could not compare for speed and versatility.

The most noticeable point about Zaneboni is the wide difference between his power of acquisition and his power of retention. In the former respect he is decidedly mediocre. Thus he required nearly seven minutes to memorize a series of 25 numbers, which he was told were to be repeated by him the next day; the next day he was unable to give more than the first four correctly. On the other hand, his power of retention was extraordinary. Its material appeared to be supplied by an automatic process of acquisition, since voluntary memorizing on his part was possible only by a distinct effort of the attention. During his years of military service, Zaneboni was frequently posted at a railroad station. He spent his spare time there in reading and re-reading the time-tables; as a result he is now able to give correctly from memory the distances between any two places in Italy, with the fares for each class. At another period in his life he memorized a list of 227 cities, Italian and foreign, with their population, which he uses in his public exhibitions; e. g., the figures representing the population of any two of these cities being given him, combined into a single number and in any order, he will give the names of the cities. He has also committed to memory a large number of squares, cubes, etc., up to the fifth power, as well as many products of two-place numbers; i. e., his multiplication table extends with some breaks to 100 x 100, instead of 12 x 12. With the help of these known solutions he is able to perform arithmetical operations with great rapidity; he recognizes perfect squares, cubes, etc., at a glance, and in performing multiplications breaks up the given numbers into parts with whose products he is already familiar. His power of retention is the sole source of this facility in calculation; he has no special aptitude for performing the operations themselves. This was clearly demonstrated by a comparison of his time with that of Diamandi and Inaudi, in the tests made on this point. In the simpler operations, involving results with which he was familiar, his time was but slightly longer than theirs; but as the task grew more complex and the numbers required more breaking up into factors according to his method, his time increased to double and sometimes even four times theirs. The tests of addition, subtraction, multiplication and division given him were identical with those given to Inaudi by Prof. Binet, so that their respective results admit of direct comparison here. The other calculators seem to have had some natural facility in handling new problems, or at least new examples of old problems: with Zaneboni the only special gift was a memory for numbers, and that was a retaining, not an acquiring aptitude.

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[1] Edited by Howard C. Warren, Princeton University, Princeton, N. J.

[2] Rivista Sperim. di Freniatria, 1897, XXIII, fasc. 1 and 2.

Another point of interest in Zaneboni was his visual type. This characteristic revealed itself in several ways. In his public exhibitions he preferred to have the numbers written out on the board, rather than spoken. His visual reactions were short from the first, and very constant (205σ). He was able to read eight figures shown by an instantaneous electric flash, while ordinary individuals were only able to distinguish three or four under the same conditions. Out of 50 words, selected from widely different spheres as a test for association, 35 gave visual associations in his case, and of the remainder 9 failed to call forth any association whatever. All these tests combined to demonstrate the essentially visual character of his ideational processes.

Like most other professional calculators, Zaneboni's interest centers wholly in his profession; beyond it he has no tastes and little general knowledge. " He rises shortly before noon, walks a little, dines at two, then walks again or goes to some café, and about seven o'clock goes to the theater. After the performance he retires, on reaching his house, shortly after midnight. He talks with few persons, shuns large gatherings, reads little, and is but little interested in what he reads, because, to use his own expression, 'his memory is always in his calculations.'" In short, while his memory for numbers is abnormally developed, all other sides of his intellect are atrophied. The tests which Sign. Guicciardi and Ferrari undertook along other lines than that of figuring failed signally, because of his lack of interest and attention. He was always inquiring what was the use of doing these—they were not in his line at all. For this reason many of the usual tests had to be abandoned or altered so as to bring in merely numerical data. However, these negative results are as truly indicative of his real nature and disdisposition as the successful tests, which they serve to conform.

Visual Perception of Depth.—Some experiments on the visual perception of depth are reported by M. B. Bourdon in the "Revue Philosophique" for January, which, if they warrant the deductions which he draws from them, will necessitate a modification of the accepted theories of space perception. The special object of the experiments was to isolate the depth data furnished directly by monocular and binocular vision, respectively, from the elements of judgment ordinarily attaching to them—such as known size, brightness, number of intervening objects, etc. To accomplish this the tests were made in a long hallway in the cellar of a large building and at night, when the cellar was completely dark. Two lanterns were placed at different distances, their light being of so small an intensity that the hall itself was not illumined; the effect was merely of two bright points of light.

In the monocular tests, the lights were first placed in position, and the subject was then led with eyes blindfolded to the spot chosen; one eye remained covered during the experiment. The subject was asked to determine which of the lights was the nearer. The experiment was tried with five subjects, and for distances ranging from 1 to 30 meters. It was found that even with the latter difference there was no preponderance of right judgments, while a slight difference of intensity between the lights led uniformly to a judgment in favor of the brighter. The author concludes that the muscular sensations accompanying changes of accommodation play no part in the estimate of depth, at least for distances greater than one meter.

For the binocular tests the author used two hallways at right angles to one another, the subject being stationed at their point of intersection. One of the lights was placed in each of the halls. When the further light was 25 meters distant, right answers were generally given when the other light was 6 meters or less; if the nearer light was 10 meters distant or more, the wrong answers predominated; the threshold value was about 7–8 meters, or a difference of 17–18 meters. Another set of experiments was tried in which the subject was asked to estimate binocularly the absolute distance of a single light. The results showed no approximation to the truth, the estimates for 50 meters being in several cases nearly the same as those for 5 meters. According to the author, the muscle sensations—in this case of convergence—play no appreciable part here; it is only the bi-retinal assimilation of corresponding points that determines our sensation of depth. Thus our perception of depth, in so far as it is a sensation at all, and not a judgment, is really a visual function, and not a muscular one, as the commonly accepted theories incline to believe. The results seem to show that the visual *sensation* horizon is about 220 meters from the eye. The spherical shape of the heavens is due to the practical parallelism of all objects further than that distance, as determined by the minuteness of bi-retinal localization, rather than to the absence of changes of accommodation and convergence for greater distances.—H. C. W.

ANTHROPOLOGY.[1]

On Fossil Bird-Bones Obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee.—On the 20th of last June (1896) the writer received from Professor E. D. Cope a small collection of subfossil bones obtained by Mr. H. C. Mercer while in charge of explorations for the University of Pennsylvania in the Bone Caves of Tennessee. These bones were kindly sent to me for the purpose of having them identified if possible, and eventually described and figured. As in the case of many cave bones, they are not encased in any matrix, being to some degree pliable rather than brittle and completely fossilized. They have a rather pale clayey color, and not more than one in a dozen of them are perfect. Indeed, it is unfortunate that so many of them are in too fragmentary condition to be identified with any degree of certainty, and in the case of a few mammal bones I found in the collection no attempt was made at identification at all. Skulls and sterna are entirely absent from this collection, nearly all the specimens being long bones, with the exception of the sacral portion of one pelvis; a few coracoids and portions of unidentifiable scapulæ, and some odd vertebræ. Under these circumstances one is obliged to be extremely cautious and careful (especially in the case of birds) in coming to an opinion as to what species the bones belonged, and whether these species are still represented in existing avian faunæ or are now to be reckoned among the extinct forms. An example of this is well exemplified in the case of a small *humerus* from the right pectoral limb of a bird in this collection. It is evidently passerine, and may have belonged to any average finch or sparrow the size of a *Carpodacus*, the bone being 2 cms. long and having all the characters seen in the humeri of that size and in that group. It is practically impossible to identify such a specimen, especially in the absence of all of the rest of the skeleton, and the fact moreover, that it possibly belonged to some extinct finch, sparrow, or other small passerine type. For these reasons too, I pass by quite a number of fragments of avian ulnæ that belonged to various species, as well as other bones of the skeleton, naming only those that can be pronounced upon with certainty.

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[1] This department is edited by H. C. Mercer, University of Pennsylvania.

PYGOPODES.

Colymbus auritus.—Represented in the collection by a perfect left femur of an adult individual, as well as by the shaft of a left humerus, and the distal end of a tibio-tarsus. These bones correspond exactly with those found in examples of this Grebe now existing. I have compared them with the skeleton of one of the species in the collections of the United States National Museum (No. 17,873).

ANSERES.

A right coracoid; a right humerus; and the proximal moiety of a right ulna (all from adult birds) appear to have belonged to some species of anserine fowl. Doubt may rest with the humerus and ulna, because they are somewhat fragmentary; but the coracoid belonged to a duck or else a Merganser; it is about the size for *Aix sponsa.* Thus far I have not identified it.

GALLINÆ.

Colinus virginianus.—That the remains of the Common Virginia Partridge occurred in these caves rests upon the discovery of the right humerus of an adult individual of this species. It is found to agree exactly with the corresponding bone in specimens of this bird now existing. There is also in the collection a left humerus of a Partridge, that might easily have belonged to either a female of this species or else to a subadult individual, or finally, to perhaps a different species. It has all the characters however, of a colinine humerus, but is smaller than the one just referred to above, and in the absence of other material I believe it to be wiser not to pronounce upon it definitely at present.

Bonasa umbellus.—Numerous bones of the Ruffed Grouse were discovered in these caves. I find in the collection a left humerus and a coracoid from the same side; two ulnæ, four carpo-metacarpi (one perfect, the others nearly so), and three tarso-metatarsi with the lower half of another. These bones have each and all been carefully compared by me with several skeletons of *Bonasa umbellus* in my private collections, and I find that they agree in all their characters with the corresponding elements of the skeleton as now found in specimens of this Grouse of the existing avifauna.

The collection contains the right carpo-metacarpus of still another Grouse, the specimen being nearly perfect. It is but a millimetre or two shorter than that bone as it occurs in adult male individuals of *Tympanuchus americanus*, being at the same time almost identical in character, in fact presenting only such very slight differences as might be due to individual variation. This bone may have easily belonged to some form of this genus abundantly represented in the existing avifauna, and in the absence of the balance of the skeleton, I am by no means sure it did not. Possibly the former owner of it may have been a female *T. americanus*, or a subadult specimen, or a male *T. pallidicinctus* and so on; while in any event, without more material for comparison, it is hardly possible to say with certainty as to what the species was, more than it was a Prairie Hen (*Tympanuchus*).

Even still more puzzling is the presence in this collection of the tarso-metatarsus of a Grouse—a perfect bone from the right limb. It does not belong to any of the species I described from the Equus Beds of Oregon, and it is too small, and at the same time, *too stout* for any existing species of *Tympanuchus;* too big for a *Pediocœtes;* and too small for a female *Centrocereus,* yet there is no question but what it is the typical tarso-metatarsus of a true Grouse. I do not believe it belongs to the same species as the one to which the above described carpometacarpus belonged, for the bone is not big enough for that quite, and yet is just possible that it might have done so. It is far better to wait for additional and fuller material to come to light from the locality where this bone was collected, before either declaring it to be a new species or not having belonged to one now abundantly represented in our existing fauna.

Meleagrinæ: Meleagris gallopavo.—The presence of the remains of the common Wild Turkey in this collection is well attested to by the following list of bones:—

Sixth cervical vertebra and the fragments of two others.
Superior extremities of seven coracoids.
Proximal two-thirds of left humerus.
Distal end of right humerus.
Fragments of the proximal ends of two other humeri.
Proximal end of left ulna.
Fragments of four carpo-metacarpi (one largely complete).
Fragment of distal end of right femur.
Distal extremities of two tibio-tarsi (♂ and ♀ ?).
Superior portions of six tarso-metatarsi and one distal end.
Three tarso-metatarsi (fragmentary), with calcars developed thereupon.

Upon comparing these bones and fragments of bones with the corresponding ones in the skeletons of *M. gallopavo*, it leaves no doubt as to their identity. And, as in this last species, very considerable difference in size is seen to exist between the sexes, as well as between the male and females when compared with the subadult individuals. Professor Marsh at different times has described three species of alleged extinct Turkeys, viz., *Meleagris antiquus*,[1] *M. altus*[2] and *M. celer*,[3] but I am very sceptical indeed in regard to the validity of the first named, *i. e.*, *Meleagris antiquus*, or in other words, I doubt the propriety of basing a new species of fossil Turkey upon "the distal end of a right humerus," as Professor Marsh has done in this case. Nor do the characters he describes for this species, as being diagnostic, hold true. It is a positive detriment to science, in my estimation, to create new species of fossil birds upon the distal ends of long bones, and surely no assistance whatever to those who honestly endeavor to gain some idea of the avian species that really existed during prehistoric times. So far as *M. altus* and *M. celei* are concerned, I can only say that I know nothing of them from a personal examination of the material upon which the species are based, and this has been refused me.

In the case of *Meleagris altus* Professor Marsh says that the length of the tarso-metatarsal is equal to 176.5 mm. (p. 261) and the present writer says that it is by no means uncommon to find the same bones in adult male specimens of *M. gallopavo* fully of that length, if not longer.

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[1] Am. Jour. Sci., II, 1871, 126.

[2] Pr. Acad. Nat. Sci. Phila., 1870, 11; and Am. Jour. Sci., IV, 1872, 260.

[3] Am. Jour. Sci., 1872, 261.

The other characters Professor Marsh enumerates may each and all be due to sexual and individual variations.

In the case of *Meleagris celer* this likewise holds true, and in regard to the statement that the "remains preserved indicate a bird about half bulk of *M. altus*," may be said with equal truth of *M. gallopavo*, in which species a similar discrepancy in size also exists between the sexes and between old and young.

In other words I am of the opinion, so far as I am able to judge from his descriptions, than when Professor Marsh described his three extinct and new species of *Meleagris*, he had nothing more or less before him than the very meagre and fragmentary remains of *M. gallopavo.*[4]

Columbidæ: Ectopistes migratorius.—The Passenger Pigeon is represented in the collection by subfossil bones from several adult individuals, viz.:—

Two left humeri (nearly perfect).
Four fragments of humeri.
One left carpo-metacarpi (perfect).
Three carpo-metacarpi (imperfect).
Several coracoids (worn, and so doubtful).
One pelvic sacrum.
One left femur (perfect).

The several bones differ in no way with the corresponding bones as they occur in adult specimens of *Ectopistes* as they exist at the present times.

STRIGES.

Megascops asio.—The Screech Owl is represented by a single specimen of a tarso-metatarsus—the bone agreeing completely with the corresponding one in the pelvic limb (of this species) of a skeleton in the private collection of the writer.

PICI.

Ceophlœus pileatus.—A right *ulna* with the extremities of the bone imperfect represents the Pileated Woodpecker in the collection. The specimen agrees exactly with the ulna of this species in the pectoral limb of a skeleton in my own cabinets. Even the prominent papillæ of the quill-butts of the secondary feathers down the shaft (and so characteristic of the ulnæ of true Pici), agree in number and in their several and corresponding distances apart, in the two bones when compared.

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[4] The relation of the specimens to the human culture layers discovered, the associated remains of the Tapir, Mylodon and other mammals identified by Professor Cope, and the shells identified by Professor Pilsbry is to be fully discussed later in the forthcoming reports of the Tennessee Expeditions of the University.

Thus it will be seen that the subfossil bones of birds in this collection from the several Bone Caves of Tennessee (so far as I have been able to identify them with certainty), belonged only to species still abundantly found in our avifauna, or were found there. Of the species enumerated below, it may be said that the Wild Turkey and the Passenger Pigeon are on the high road toward total extinction.

Colymbus auritus.
Bonasa umbellus.
Ectopistes migratorius.
Ceophlœus pileatus.
Colinus virginianus.
Meleagris gallopava.
Megascops asio.

To these may be added a doubtful Duck and a Grouse, while still other bones represent species that cannot be satisfactorily identified until the skeletons are made more complete by the discovery of additional material.—R. W. Shufeldt.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Torrey Botanical Club.—Wednesday evening, March 31, 1897.—The first paper, by Dr. Albert Schneider, " The Phenomena of Symbiosis," and a paper by Leonard Barron on " Horticulture in Botanical Gardens," were read by title.

The evening was occupied by a paper by Prof. Edward S. Burgess on " Aster macrophyllus and its Allies," illustrated by chart of relationship and by numerous specimens. The speaker sketched briefly the history of the species *Aster macrophyllus*, in which it has been the custom of American botanists to include all large leaved Asters. He showed how diverse these Asters are, and in what confusion their assignment to a single species results, and indicated the characters according to which they form two groups each of several species and varieties.

The paper which will soon appear in print, was discussed by Mr. E. P. Bicknell, who confirmed the distinctions offered by the results of his observations about New York, and by Dr. Britton, who paid a tribute to the masterly manner in which Dr. Gray had treated the subject of the genus Aster so far as material was then available, and who referred to the special need for extended field work and further collaboration which this genus had long presented.

Tuesday evening, April 13th.—Dr. Albert Schneider presented a paper entitled "Methods Employed in the Examination of Powdered Drugs and their Adulterants."

He described certain microscopic structural features which he had investigated with a view to find characters by which to distinguish the more important drugs, giving details of such characteristics determined by him for mace, senna, leaves of Eucalyptus globules, etc.

Dr. Britton spoke of the utility of this work and of its objects in behalf of the new edition of the U. S. Pharmacopeia.

Wednesday evening, April 28, 1897.—In the absence of officers, Professor Underwood was elected Chairman of the meeting and Professor Britton Secretary pro tem. There were 26 persons present.

The Chairman announced to the Club the recent death of Dr. Emily L. Gregory, Professor of Botany in Barnard College, and remarked on her life and works. Dr. H. M. Richards, Dr. H. H. Rusby and Miss Alexandrina Taylor were appointed a committee to draw suitable resolutions and report them to the Club at a subsequent meeting.

The scientific program comprised the following papers:

1. By Professor L. M. Underwood: "Notes on the Ferns of Japan." (Abstract).

The immediate occasion of this paper was the receipt during the past year of two separate collections of Japanese ferns of about 50 species each, which, being from different portions of the island, scarcely duplicated each other. Some of the more interesting were shown, including *Camptosorus sibiricus, Cystopteris japonica* and *Struthiopteris orientalis.*

The insular position of Japan together with a considerable range of latitude, equalling that from St. Paul, Minn., to Mobile, Ala., gives Japan a larger proportion of ferns than we have in the United States, although the area of the islands is only that of the northeastern States as far as the Virginias together with about one-half of Ohio.

The ferns are those of temperate climates and agree well with those of the adjacent mainland so far as the latter are known. A few subtropical forms enter the flora, but the really tropical species do not reach the islands.

Many species are common inhabitants of Europe as well as the eastern United States, but the ferns of Japan offer very little support to the once prevalent notion of the great similarity to the flora of the eastern United States. In fact about as many Japanese species have as many near allies in Pacific America as in other portions of the country if we exclude the species quite generally distributed through the North Temperate Zone.

Discussing the paper, Professor Britton cited a number of instances among spermatophytes, in which species supposed to be common to Japan and eastern North America, has been shown to be distinct. He maintained that the theory of migration, as ordinarily accepted, was insufficient to account for such similarity between the floras of the two regions as actually exists. Mr. T. H. Kearney, Jr., remarked that in comparing the grass-flora of the two regions, he had found that exclusive of circumboreal species, only two species are in common.

The second paper was by P. A. Rydberg, entitled "Floral Features of Western Nebraska."

It is a popular misconception that the country from Illinois to the Rocky Mountains constitutes one undifferentiated region. In fact, there are two entirely different regions, viz.:

1. The Prairie Region, with rich loam and a comparatively good supply of rain, extending to the Eastern Dakotas, Nebraska and Kansas.

2. The Region of the Great Plains, with dry, hard soil and scanty rain-fall, comprising the western portion of said States, eastern Colorado and Montana and the lower portion of Wyoming. In Nebraska the prairie region includes the eastern and south central portion of the State. The north central portion constitutes a region unique to Nebraska, the Sand-Hill Region, spoken of in one of the February meetings of the Club. Mr. Rydberg corrected a statement made by him then, viz., that he had seen "blow outs" in that region 300 feet deep. He had intended to say 300 feet in diameter and 60 to 70 feet deep.

The western portion of the State is made up of high plains, except a small portion of the northwestern corner containing the "Pine Ridge" and the "Bad Lands" of White River and Hat Creek. The plains have very few rivers, and the drainage is mostly by means of "sand-draws." Seen from a hill a sand-draw resembles a well beaten and winding sandy road. It is a stream with no visible water. The water is running from one to fifteen feet below the surface. Even the larger streams as the Lodge Pole and South Platte sometimes sink down in the sand.

The plains are mostly covered by short grasses, the so-called Buffalo grasses. In the hot, dry autumn, these become self-cured, and form an excellent winter pasture for the stock. A little hay is cut on the lowlands and fed to the animals during snow-storms. Otherwise the cattle and horses feed out during the whole winter. The Buffalo grasses are: the original Buffalo grass *Bulbilis dactyloides*, Blue and Black grama *Bouteloua oligostachya* and *hirsuta*, and "Nigger Heads," *Carex filifolia.*

In a region where the rain-fall is comparatively scant and distributed only during certain seasons of the year, the plants must be so constituted as to be able to withstand a good deal of drought. In other words, the evaporation must either be reduced to a minimum or the plant must have special stores of water. The plants peculiar to this region may be divided in the following groups:

1. Very hairy plants generally covered by thick pannose pubescence, which retain the moisture, as species of *Eriogonum, Astragalus, Eurotis, Senecio, Evolvulus* and *Artemisia.*

2. Plants with glaucous foliage having a hard epidermis, as *Yucca glauca, Rumex venosus, Argemone alba*, and several grasses.

3. Plants with white, often shreddy bark, as species of *Mentzelia* and *Anogna.*

4. Plants with very narrow and often involute leaves, as *Lygodesmia juncea* and *rostrata* and several grasses and sedges.

5. Plants with fleshy stems in which the surface is reduced to a minimum and no leaves, as the *Cacti.*

6. Plants with a deep-seated, enlarged root, as the Bush Morning-glory *Ipomœa leptophylla*, and the Wild Pumpkin *Cucurbita fœtidissima.* Mr. Rydberg had seen a root of the former 3 feet long and almost 2 feet in diameter.

7. Plants covered with glands, containing essential oils, as *Dysodia papposa* and *Pectis angustifolia.* The oil is supposed by some to have a cooling effect, partly by taking up heat when evaporated and partly by surrounding the plant by a cooler atmosphere, their specific heat being much less than the air.

Numerous specimens were exhibited.

Three papers followed by Dr. J. K. Small, "(a) The Sessile-flowered *Trillia* of the Southern States," (b) "Notes on Epilobiaceæ." Both papers are published in the April issue of the *Bulletin.*

Dr. Britton exhibited a specimen of *Silene conica* L., collected by Mr. A. D. Selby at Clyde, Ohio. This species is a recent immigrant from Europe.

N. L. BRITTON, *Secretary, pro tem.*

New York Academy of Sciences.—Biological Section.—April 5, 1897.—The Chairman, Prof. E. B. Wilson, in the chair. Twenty-two persons present. Prof. Osborn moved that a committee be appointed to consider and take action on the question of postage on

Natural History specimens. The Chair appointed Doctors Dyar and Dean and Prof. Stratford.

Professor Bristol offerred his resignation as Secretary. It was accepted, and the election of his successor was laid over until the next meeting.

Prof. Osborn reported upon the phylogeny of the early Eocene Titanotheres, showing that they are divided into two distinct series included under the genera Telmatotherium and Palæosyops, both of which independently acquired horns. The Telmatothere line begins with *T. boreale*, a form which Cope referred to as Palæosyops. It is distinguished by animals with long narrow skulls and high stilted feet, and undoubtedly represented the upland types of the family. The Palæosyops line, as suggested by Earle and Hatcher, passes through *P. laticeps* and *P. manteoceras* and leads up to Dipladodon, the larger species of which surpass in size the smaller Titanotheres of the Oligocene. This main line gives off several collaterals, such as *P. paludosus*. Lambdotherium does not belong in the *Titanothere phylum* at all.

A second note related to a division of the two groups of placental mammals, the Meseutheria and Ceneutheria. The former, since Wortman's demonstration that the Ganodonta are ancestral edentates, must now embrace this division, besides the Creodonta, Lemuroidea, Tillodontia, Insectivora, Amblypoda and Condylarthra.

The third note related to the origin of the typical mammalian types of teeth among the Theriodonta, Cynodontia and Gomphodontia of the Triassic. It is especially noteworthy that the Gomphodontia afford a demonstration of the origin of Multituberculate teeth from a trituberculate ground plan, as hypothetically assumed by the speaker some years ago.

Mr. Bradney B. Griffin reported that in Thalassema (one of the Echiurids) the spireme occurs in minute ova (3 micra in diameter) floating clusters in the body cavity. The spireme segments into one-half the somatic number of chromosomes, which by partial longitudinal splitting pass into flattened ellipses. These elongate, and during the growth period become twisted and distorted, and their true shape thereby obscured. While entering the first polar spindle they appear as loose open rings or compact rods (bivalent). These by concentration and looping-up form crosses, opposite arms of which are attached to the "Zugfasern." During metaphase the crosses become drawn out into flattened ellipses which split across into two V's with closely apposed limbs. At telophase the latter separate at the angle and diverge in the second polar mitosis. No longitudinal splitting of the V's occurs.

In Zirhæa (Lamellibranch) the process is identical, although more obvious by reason of the less close apposition of the halves of the rings and V's. The conclusion is that in both forms a reducing division takes place.

Mr. J. H. McGregor offered a preliminary report on the development of the Spermatozoa in Amphiuma.

Prof. F. E. Lloyd's paper on Pholadidæa of the Pacific Coast was read by title.

May 3, 1897.—The Chairman, Professor E. B. Wilson, in the chair. Fifteen persons present. Mr. Gary N. Calkins, of Columbia University, was elected Secretary.

In the absence of Dr. Dyar, Chairman of the Committee appointed to consider the question of postage on Natural History specimens, Professor Stratford reported that the Postmaster General had been notified, and that the matter had received due consideration.

Upon behalf of the Committee appointed to draw up a resolution relating to the death of Professor Cope, Professor Osborn delivered a brief eulogy of the great naturalist, pointing out the especial features which have made his work famous and have given him such a high position in the history of Natural Science. He dwelt especially upon the fact that Professor Cope prosecuted five great lines of work simultaneously, and that in each he acquired a commanding position. He also spoke of some of his generous qualities as a fellow scientific worker, especially his liberality in the loan of collections and generous recognition of the work of others. Finally, he alluded to his remarkable independence and fortitude of character, and persistent devotion to science, even with limited resources. His death leaves a vacuum especially in the line of able and accurate criticism of contemporary work. Professor Osborn concluded by submitting the following resolution :

The members of the New York Academy of Sciences desire to record their admiration of the noble services to Science of the late Professor Edward D. Cope. Since 1859, when he offered his first contribution to the Philadelphia Academy of Sciences, at the age of nineteen, he has been a devoted and brilliant investigator in five great branches of Natural History, ichthyology, herpetology of the batrachians and reptiles, mammalian palæontology, historical geology and philosophy. In each he has long been an acknowledged leader, and his combined knowledge of all has given his researches a philosophical breadth, grasp and permanence, which place him among the great masters of Comparative Anatomy, Cuvier, Owen and Huxley. We deeply regret that his untimely death has cut short his life work, and feel that the loss of his keen critical and productive faculty deals a blow to the cause of comparative anatomy of the vertebrata throughout the world which can hardly be measured. We tender to the American Philosophical Society and to the Academy of Natural Sciences of Philadelphia, of which Professor Cope was a life long member, an expression of our deep regret at their loss, and of our readiness to coöperate with them in the establishment of some suitable memorial.

Signed { HENRY F. OSBORN.
J. L. WORTMAN.

Mr. H. E. Crampton, Jr. gave a brief abstract of a paper by F. C. Baker on "Notes on Variations in the Apex of Gasteropod Molluscs."

Professor Bashford Dean and Mr. F. P. Summer reported on the spawning habits of *Petromyzon wilderi* at Van Cortlandt Pond.

Mr. H. E. Crampton, Jr. reported on some Coalescence-Experiments with Lepidoptera.

A paper on the "Vertical Distribution of Plankton in Deep-Sea Collections from Puget Sound" by Prof. James I. Peck and Mr. N. R. Harrington was read by title.—GARY N. CALKINS, *Secretary.*

The Academy of Science of St. Louis.—At the meeting of the Academy of Science of St. Louis on the 7th of June, 1897, twenty-one persons present, Mr. Robert Combs, of Ames, Iowa, presented a paper entitled Plants Collected in the District of Cienfuegos, Province of Santa Clara, in 1895–1896. The paper embraces the results of a collection extending from the commencement of the rainy season of one year until the close of the dry season the following spring, the territory covered by the collection lying between the entrance of the Bay of Cienfuegos, on the south coast of Cuba, up the bay and the river Damuji to Rodas, and extending back from the river to Yaguaramos and almost to the Cienega de Zapato, a region including nearly all kinds of soil and condition found upon the island, except those of the mountain regions and the mud swamps. A brief statement was made concerning the origin of the Cuban flora and its affinities with that of continental Central America, rather than the geographically nearer Floridan region.

The paper comprised a full catalogue of the collections made, which had been determined at the herbarium of Harvard University, and of which several sets had been distributed to the larger herbaria.

Professor F. E. Nipher made some remarks on the difficulties yet involved in the theories of the ether.

WILLIAM TRELEASE, *Recording Secretary.*

SCIENTIFIC NEWS.

The following changes made by the Postal Congress will interest naturalists generally :—

1. The principal treaty, the entry of Corea into the Postal Union, the declaration of the Orange Free State, which had not yet sent a delegate to Washington, that it hoped in a short time to enter into the Union; the declaration of the empire of China, represented in the congresses, that it will adhere to the union as soon as the organization of its service permits it.

2. Uniform colors have been adopted for postage stamps.

3. Postal cards unpaid are subject to a double tax, that is four cents in place of a tax equal to that upon letters unpaid, which is 10 cents.

4. Circulars produced on a typewriter in quantities of twenty circulars or more, all of the same character, are admitted at same tariff as are printed circulars.

5. Samples of merchandise are admitted up to 350 grammes, except in the case of a contrary arrangement, when the maximum weight will be 250 grammes.

6. Objects of natural history, animals, dried plants or preserved zoological specimens are admitted as samples.

7. The question of the creation of a universal postage stamp has been negatively decided on account of the difficulties which will occur in putting in practice that important innovation, and especially because of the diversity of the units of money of the various countries.

The next session of the Congress, the sixth one, will be held at Rome, Italy, in February, 1903.

In a letter to *Forest and Stream*, Mr. Bainbridge Bishop deprecates the action of the U. S. Fish Commissioners in stocking the trout and land locked salmon lakes with smelt. While it is true that adult trout fatten on the smelt, the smelt can also fatten on the young trout and salmon, the smelt being 1,000 to 1 in the majority. The absence of trout in Lake Champlain from Westport to Cumberland Head, an ideal lake trout water, he attributes to smelt which are found at all times of the year in all the deeper parts of the lake, and in the identical depth of water that would naturally be inhabited by young and adult trout. His observations go to show that the introduction of smelt into the great lakes would be almost a national calamity, foretokening the extinction of trout fishing, both commercial and sporting.

Prof. G. O. Sars who has for many years been studying the various groups of Crustacea has in preparation a complete account of the Crustacea of Norway, and his work is now in course of publication by the Bergen Museum. All the known Norwegian species will be described and figured. Parts III and IV of vol. I, containing descriptions and illustrations of five families of Isopods, viz., Anthuridæ, Gnathiidæ, Aegidæ, Cirolanidæ, and Limnoriidæ, have just been issued.

Among recent deaths we notice: H. d'Achon, coleopterist, at Orléans; Dr. Maurice Teinturier, coleopterist, at Clayeures, France; Edmund Neminar, formerly professor of mineralogy and petrology in Innsbruch, on April 10, 1897, at Vienna; Karl Kölbel, custodian of the Natural History Hofmuseum at Vienna; Ludwig Juranyi, professor of botany at Budapest, February 27th; Dr. A. Kumgott, professor of mineralogy at Zürich, March 15, aged 79.

Dr. W. H. Evans, of Washington, D. C., has gone to Alaska for several months to investigate the agricultural resources and possibilities of that portion of the territory lying south of the Aleutian peninsula. He will report to Congress as to the advisability of establishing experiment stations there. Dr. Sheldon Jackson is to collect similar information regarding the Yukon Basin.

Professor Nelson, the University of Wyoming botanist, will make an excursion into the Red Sea Desert. This tract of land has never received a botanical investigation, and the professor has planned to make three other trips into the desert during the summer. He expects to obtain many rare botanical specimens.

A proposition is under consideration in the English scientific societies for the establishment, in commemoration of the sixtieth year of Her Majesty's reign, of a Victoria research fund, to be administered by representatives of the various scientific societies for the encouragement of research in all branches of science.

Professor Bruner, of the University of Nebraska, has sailed for Buenos Ayres, where he will spend a year investigating the injurious locusts which have, of late, increased enormously in three of the eastern provinces of the Argentine Republic.

Dr. Ludwig Heim goes to the University of Erlangen as professor extraordinarius of bacteriology; Dr. Vladislaw Szymonowicz of Cracow goes to Lemberg as professor extraordinarius of histology and embryology in the university there.

At its commencement exercises, on June 15th, Johns Hopkins gave its first doctors' degrees in medicine. One of the recipients is Miss Mary S. Packard, the only one of her sex in the class.

The Field Columbian Museum, Chicago, has purchased from the widow of Dr. Arthur Schott, the plants collected by him in Campeche, Tabasco, Upper Mexico, Hungary, and elsewhere.

Dr. Edward Fischer has been advanced to the position of professor of botany in the University of Berne; Dr. Gaupp to the professorship extraordinary of anatomy in Freiburg.

The gold medal of the Linnean Society of London has been conferred upon Dr. Jacob Georg Agardh, Emeritus Professor of Botany at the University of Lund.

The endeavor, at Cambridge, to open a possibility for the reception of degrees by women has been defeated by an overwhelming vote of 1707 to 661.

Drs. E. Barclay-Smith and F. C. Kempson have been appointed senior and junior demonstrators of anatomy in the University of Cambridge.

Johann S. Kubary, who probably knew the islands of the South Sea as well as any one, died at Ponapé, Caroline Island, the last of October, 1896.

The general board of studies at Cambridge propose to establish a lectureship in experimental psychology at a stipend of £50 per annum.

The degree of Doctor of Philosophy was conferred upon Mr. Roscoe Pound by the University of Nebraska at its recent commencement.

Mr. Edward Dodson has left England for Morocco, with the object of investigating the fauna of the country around the Atlas range.

Dr. E. Fischer has been made full professor of botany in the University of Berne and director of the botanical gardens there.

Professors Bütschli and Weismann have been elected to corresponding membership in the Academy of Sciences of Berlin.

Dr. Georges Ville, professor of vegetable physiology in the Museum of Natural History at Paris, died February 23, 1897.

Professor Conway Macmillan goes to Europe for the summer on business connected with the University of Minnesota.

The Royal Society of Edinburg has elected Professors Zirkel, Heidenhain and Cohn to honorary membership.

Mr. W. Garstang has been appointed naturalist to the Marine Biological Association at Plymouth, England.

Mr. Robert Douglas, well known in the line of arboriculture and forestry, died June 1st at Waukegan, Ill.

Dr. J. S. Kingsley is to spend the summer in Jamaica, as also is Dr. J. E. Humphrey and Dr. W. K. Brooks.

Dr. W. B. Pillsbury has been elected to an instructorship in psychology at the University of Michigan.

Dr. Johannes Martin has been appointed director of the Natural History Museum in Oldenburg.

Miss Mary E. Pennington has been made fellow in hygiene at the University of Pennsylvania.

Dr. P. Francotte has been elected professor of embryology at the University of Brussels.

Prof. J. L. Prevost has been made professor of physiology in the University of Geneva.

A gift of $100,000 was made McGill University by the will of the late J. H. R. Molson.

The Catholic University of America has received $5,000 as a foundation for a fellowship.

Dr. H. K. Wolfe has resigned the chair of psychology at the University of Nebraska.

Dr. J. J. Zumstein has been made professor of anatomy at the University of Marburg.

Dr. J. H. Leuba has received a position in psychology at Clark University.

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NEW OBSERVATIONS ON THE ORIGIN OF THE GALÁPAGOS ISLANDS, WITH REMARKS ON THE GEOLOGICAL AGE OF THE PACIFIC OCEAN.

By G. Baur, Ph. D.,

ASSOCIATE-PROFESSOR OF PALEONTOLOGY, UNIVERSITY OF CHICAGO.

In December, 1890, I wrote a paper,[1] "On the origin of the Galápagos Islands," which was published in the American Naturalist of March and April, 1891, one month before I left for the archipelago. This paper opens with the following remarks: "All islands can be divided into two principal groups: 1. Islands developed from continents or larger bodies of land through isolation or subsidence—*Continental Islands.* 2. Islands not developed from continents, but from submarine portions of the earth—*Oceanic Islands.*

"The flora and fauna of the first group will be more or less *harmonic*—that is to say, the islands will be like satellites of the continent from which they developed, and the whole group comparable to a planetary system. The flora and fauna of the second group will be *disharmonic*—that is to say, it will be composed of a mixture of forms which have been introduced accidentally from other places. It is evident the first group of islands will be affected gradually in the same way; there will be immigrants from other localities besides the original inhabitants.

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[1] Baur, G. "On the Origin of the Galapagos," American Naturalist, March, 1891, p. 217–229; April, 1891, p. 307–326.

"*Continental islands, therefore, may be composed of two floral and faunal elements: first, an original (endogenous) one; and second, a secondary (exogenous) one. Oceanic islands, however, will only contain a secondary (or exogenous) floral and faunal element, they never will show harmonic distribution.*"

By the study of the Galápagos Islands I reached the conclusion that the distribution of the animals was harmonic, and that the theory of the oceanic origin was therefore not correct.

This opinion I have sustained in the following papers: 1. Das Variiren der Eidechsen-Gattung Tropidurus auf den Galápagos Inseln., Biol. Centralbl., Vol. X, 1890, p. 475–483. 2. Account of my Trip to the Galápagos Islands, dated Chatham Island, August 28, 1891, AMER. NAT., Vol. XXV, 1891, p. 902–907. 3. Ein Besuch der Galápagos Inseln., Biol. Centralbl., Vol. XII, 1892, p. 221–250, also H. de Varigny. Voyage scientifique aux Isles Galápagos, Revue Scientif., Vol. 50, No. 13, 24 Sept., 1892, p. 391–400. 4. Das Variiren der Eidechsen-Gattung Tropidurus auf den Galápagos Inseln. Festschrift zum siebenzigsten Geburtstage Rudolf Leuckart's, Leipzig, 1892, p. 259–277, 4° (with variation curves). 5. The Differentiation of Species on the Galápagos Islands and the Origin of the Group, Biol. Lect. Marine Biol. Laborat. Wood's Holl., 1894, Boston, 1895, p. 67–78.

In this last paper I gave a table showing the distribution of seven genera on the Galápagos Islands; I also gave a table of the distribution of seven genera of birds on the West Indies. Since the West Indies show harmonic distribution, and since it is proved that they were formed by the splitting up of a continuous land area, the same must be true for the Galápagos.

This paper has been reviewed by Professor F. Ratzel in Leipsic, Professor S. Günther in Munich, and Professor O. Böttger in Frankfort. They all agree with my view. Ratzel says: "Baur concludes from the 'harmonic distribution' of the variations that the Galápagos, like the Antilles, originated by sinking of the sea bottom, and were certainly not formed by single volcanic islands, that they were formerly connected through Cocos Island with Central America." He correctly rejects the hypothesis of the consistency of continents and oceans. (Dr. A. Petermann's Mitteilungen, 1895, Heft 12, p. 184–185.)

Günther[2] remarks: "It is known and generally admitted, that for the solution of the question about the origin of a certain island, or a group of islands, the application of zoogeography is of the highest value. The paper before me shows how important it will be for physiography, if correctly applied. Professor Alexander Agassiz had insisted that the Galápagos Islands never had been in connection with the American continent, but were typical volcanic islands. But, if the single islands are all of marine origin, if they were occupied only later by organisms from the continent, fauna and flora ought to show a pretty variegated aspect, making an impression of a mixture of forms. There would be no reason, why one of the islands, which are all closely placed together, should have been preferred to another one, if really the currents of the air and the sea alone effect the transportation of organic germs.

Baur's detailed examination revealed a totally different picture. He showed that each, or nearly each island, has peculiar representatives of certain genera, Tropidurus, birds, etc. This can only be explained by subsidence. The tables given by Baur of the distribution cannot be misunderstood. The Galápagos must be considered as the remains of a Miocene land—connection with the continent, to which belonged probably also the West Indian Archipelago."

Böttger[3] also agrees with me, and finishes his review with the following sentence: "Baur finally reached the conclusion, that the lines of the continents of former geological periods do not agree at all with those of the present continents, the more we go back in geological time the larger are the differences." "With this theoretical exposition he gives us an interesting example, that by biological research deductions can be made for geological problems."

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[2] Günther, S. Naturwissensch. Rundschau, 1895, No. 42, p. 542–543.

[3] Böttger, O. Zoolog. Centralbl., I, No. 15, p. 401–463, Sept. 2, 1895.

Ortmann[4] is of the same opinion, and referring to my papers, he says: "The Galápagos Islands may be considered a classical example of the influence of separation for the formation of species."

Meanwhile Mr. Townsend's[5] paper on the Birds of Cocos Island had appeared, the results of which showed to be very interesting for the question of the origin of the Galápagos.

Dendroica aureola Gould, *Cocornis Agassizi* Townsend, *Nesotriccus ridgwayi* Townsend, and *Coccyzus ferrugineus* Gould were found, the last species having only been known before. *Dendroica aureola* Gould occurs also on the Galápagos, besides it has been recorded on Gorgona Island, on the southeast coast of Columbia, north of Tumaco; at Esmeralda, Ecuador; and Posorja, north of the Island of Puna, in the Gulf of Guayaquil; in western Peru, at Santa Lucia and Tumbez. *Cocornis Agassizi* Townsend is the representative of *Cactornis* (Gray) of the Galápagos, and *Nesotriccus ridgwayi* Townsend very close to *Myiarchus magnisostris*. *Coccyzus ferrugineus* Gould is related to species of Central America and the West Indies. *Cocos Island* is placed between the Galápagos and the Cordillera de Veragua. The 1500-fathom line probably embraces Cocos Island and the Galápagos from the Island of Coiba.

We shall now consider the botanical evidence.

During my visit of the Galápagos (June 10–September 6, 1891) I collected plants on Albemarle, Indefatigable, James, Chatham, Charles, Hood, Gardner, Bindloe, Abingdon, Barrington, Tower and Jervis. These have been determined at the Gray Herbarium of Harvard University by Mr. B. L. Robinson and J. M. Greenman.[6]

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[4] Ortmann, Arnold E. Grundzüge der marinen Thieregographie, Jena, 1896, p. 29; and "On Separation, and its Bearing on Geology and Zoogeography," Amer. Journ. Science, Vol. II, 1896, p. 63-69.

[5] Townsend, C. H. Birds from Cocos and Malpelo Islands, with Notes on the Petrels obtained at Sea. Bull. Mus. Zool., Harvard College, Vol. XXVII, No. 3, Cambridge, July, 1895, p. 121–126.

[6] Robinson, B. L., and J. M. Greenman. Contributions from Gray Herbarium of Harvard University, New Series, No. IX, I. On the Flora of the Galápagos Islands, as shown by the Collections of Dr. G. Baur, Amer. Jour. Science, Vol. L, August 1, 1895, p. 135–149.

From this paper I quote the following: "It is well known not only that the archipelago possesses a peculiar and remarkable vegetation, but that the different islands exhibit in their floras a striking individuality." "While upon some of the smaller islands Dr. Baur collected only a few species, enough material is at hand not merely to confirm strongly the view that almost every island has its peculiar species and varieties, but to show clearly that even plants, which must pass as the same species, often exhibit, when found upon several islands, more or less striking racial differences. These facts, while in other respects noteworthy, derive a special interest from their relation to the probable origin of the flora of the group. Regarding the fauna Dr. Baur has in several recent articles called attention to peculiar harmonic relations existing between the forms of the different islands, and has argued from zoological grounds that the islands must at one time been united, not only with each other but with the mainland near Central America." "This view has been severely criticised by several writers, but no one has attempted to account for the peculiar distribution of differing, yet closely related forms upon the islands, and as the subject is one which merits further attention, it seems worth while to present the botanical data in some detail.

Perhaps no species to be found upon the different islands better illustrates the noteworthy racial divergence in related forms than *Euphorbia viminia* Hook. fil. This species differs markedly in foliage from any other known member of this large genus, and is characteristic of the Galápagos Archipelago. Being essentially a desert plant, it can subsist even upon those islands of the group which are of low altitude and do not attain the upper regions of moister atmosphere. It was first collected by Macrae upon Albemarle, rediscovered by Anderson on Charles, and has now been collected by Dr. Baur on the following islands: Barrington, Chatham, Southern and Eastern Albemarle, James, Jervis, Bindloe, Tower and Abingdon. Even the most cursory inspection of the forms from these different islands discloses marked variation in the contour, size, thickness, rigidity, and color of the leaves, as well as in the length of the intenodes, color of the stem, etc., while more careful examination shows that these are not mere individual differences, due to chance, state of development, or individual environment, but each form appears in general to be restricted to a single island. Some forms, such as those from Abingdon and Tower Islands, differ rather strikingly from the rest, while others present slighter differences, in a few cases too slight, that a series of careful measurements is necessary to demonstrate their existence. But the examination of considerable number of specimens, such as those secured by Dr. Baur, shows that the species as it occurs on each island differs in some characteristics, slight or more considerable from the forms of all or nearly all the other islands, and furthermore, each island appears to have only *one form* of its own.

The question at once presents itself: If this archipelago is composed of islands of elevation, built up from the sea-floor independently by volcanic action, how has such a distribution been effected? If the vegetation has been derived from the mainland by the chance of transportation of seeds, it is quite impossible to believe that each island has received a slightly different form of the same species, and we are forced to the much more natural assumption that racial and varietal divergence has come about after the introduction of the species upon the islands. Now, continuing the supposition that these are islands of elevation, the seeds of *Euphorbia viminea* must have reached them in one of two ways: either each of the nine islands, where we know the species now to occur, must have received its seed directly from the mainland; or, what is much more natural, seed must have reached one or more of the islands, and from there spread to the rest. That the same species should have reached all these islands presupposes a considerable facility of transportation. But as soon as this is granted it is impossible to understand the highly individual development of the forms upon the different islands. For relative or complete isolation seems necessary to account for the racially divergent floras of the islands; and especially for the occurrence of only one form upon each island. It would thus appear necessary, in accounting for the present distribution, to assume that at one time in the remote past the islands were either united, or at least that the channels which separate them were less formidable barriers to seed transportation than at present, so that general distribution of species could have been effected ; and that subsequently, as the islands separated, or as the channels through some change of currents, or other cause, became less easily passed, an era of *much* greater isolation of the floras of the different islands came about. The divergence of character of the vegetation would then begin at once, and the otherwise unaccountable existence of a single and peculiar form upon each island would be readily intelligible."

While not prepared to make any positive assertion regarding the probable origin of the islands, the authors fail to see in the hitherto generally accepted theory of elevation any satisfactory explanation for the harmonic yet divergent floras of the different members of the group. Upon Dr. Baur's assumption of a former union between the islands and subsequent separation by subsidence, not only is explanation possible, but the existing flora of the archipelago is just that which would most naturally result from such an origin. A former union of the islands would account at once for the occurrence of identical ancestral species upon the different members of the group, and the subsequent separation give the needed isolation for varietal and racial divergence, while the latter could not have come about if a continental interchange of seeds were taking place from island to island.

Regarding a former land-connection with the continent, which would certainly offer much greater geological difficulties, the botanical evidence is still too vague to merit regard. The affinities of the vegetation of the upper, moister portions of the islands are doubtless, as has been assumed, with the floras of Columbia, Central America, Southern Mexico, and the West Indies, while much of the desert flora of the lower regions has doubtless been derived from the arid regions of Chili and Peru. But, so far as botanical data are concerned, this could have come about either by migration by land or by transportation by oceanic currents, and, as the latter still exist, it seems unnecessary to assume the former. However, on this point, the evidence from the vegetation appears to be still wholly indecisive.

The harmonic relation of the floras of the different islands, which, as we have seen, appears to have such an interesting bearing upon the former possible connection of the islands with each other, is shown not only by *Euphorbia viminea*, but by various other endemic species and groups of species of the same and other genera and orders.

All the Galápageian species of *Euphorbia* for instance, with the exception of *E. amplesicaulis* Hook. fil., form a closely related group, doubtless having a comparatively recent common ancestry; but most of these forms are characteristic of particular islands. The same is eminently true of the different species of *Acalypha*. The *Borreriæ* of the Galápagos Islands also form, for the most part, a close group of very nearly related species, or, perhaps, better varieties of one polymorphous species, all of which have probably diverged from a uniform parent stock after the separation of the insular floras from that of the mainland and from each other. Here, however, we find in some instances the same form upon two or more of the islands, as though transportation of the seed had offered somewhat less difficulties than in the case of *Euphorbia viminea*." The forms of *Euphorbia viminea* Hook. fil. are as follows:

Forma *Albemarlensis* (typica).[7]—Albemarle Island; collected first by Macrae, and again by Dr. Baur, on the southern end of the island in July, and on the eastern side in August, 1891.

Forma *Jacobensis*.—Collected by Dr. Baur near Orchilla Bay, Northern James Island, August, 1891.

Forma *Castellana*.—Collected on Tower Island, by Dr. Baur, September 1891.

Forma *Chathamensis*.—Collected on Chatham Island, lower region, southwest end, by Dr. Baur, June, 1891.

Forma *Carolensis*.—Collected on Charles Island, by Anderson, 1852.

Forma *Barringtonensis*.—Collected on Barrington Island, by Dr. Baur, July, 1891.

Forma *Jervensis*.—Collected on Jervis Island, by Dr. Baur, August, 1891.

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[7] I do not give here the description of these varieties, which may be looked up in the original paper.

Var. *Abingdonensis.*—Collected on Abingdon Island, by Dr. Baur, September, 1891. This form is so well marked as to merit varietal rank.

In *Amarantus sclerantoides* Ands. a racial variation has been noted similar to that in *Euphorbia viminea.* The type of the former was collected on Charles Island by Anderson. Two forms collected by Dr. Baur upon Chatham and Hood Islands differ perceptibly in foliage:

Forma *Chathamensis.*—Collected at Chatham Island, lower region, southwest end, June, 1891.

Forma *Hoodensis.*—Collected on Hood Island, July, 1891.

We shall now see what Mr. W. Botting Hemsley,[8] of the Royal Kew Gardens, has to say, who is a specialist in insular floras.

In 1894 the first part of a splendid series of papers appeared in *Science Progress* under the title, "Insular Floras," in which some remarks about the flora of the Galápagos are made. At the end the following sentence occurs:

"Concerning the origin of the fauna and flora of the Galápagos, Agassiz vigorously attacks and ridicules Baur's theory of subsidence, put forward with so much confidence, and briefly stated thus: '*The Galapagos are continental islands, originated through subsidence;* they all formed at a past period one large island, and this island itself was at a still former period in connection with the American continent.'[9] It will be sufficient to have directed attention to the discussion here. It is worth adding, however, that Baur's article is supplemented by an excellent bibliography."

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[8] Hemsley, W. Botting. Insular Floras. Science Progress, Vol. I, No. 5, July, 1894, p. 400-401.

[9] These words occur in my paper on the "Origin of the Galápagos Islands," April, 1891, p. 307, published before my departure. The sentence which expresses my theory is preceded by the following words: "I started with the sentence that continental islands must have a harmonic flora and fauna. In the Galápagos we found absolute harmony; my conclusion, therefore, is," etc. I have replied to the criticisms made by Prof. Agassiz in his "General Sketch of the Expedition of the Albatross," from February to May, 1891, (Bull. Mus. Comp. Zool., Harvard Col., Vol. XXIII, No. 1, Cambridge, Feb., 1892) in Science, Vol. XIX, No. 477, March 25, 1892, p. 176. From this I quote the following: "Professor Agassiz has completely overlooked the main point of my argument. This I considered the harmony in the distribution of fauna and flora, as will be seen by referring to my paper. I tried to show that this harmony was absolutely unexplainable by the theory of elevation. After this was done, I examined whether our present knowledge of the soundings showed any serious obstacle to

On October 24, 1895, Hemsley[10] published a review of Robinson's and Greenman's Flora of the Galápagos Islands.

" Dr. G. Baur's theory of the origin of the Galápagos Islands is too well known to need explanation here; yet, it may be briefly designated the theory of subsidence. He argues that the islands were formerly connected with each other, and at an earlier period with the American continent. It is also almost needless to say that this theory has met with an exceedingly hostile recognition. The publication of an account of the botanical collections (Robinson and Greenman) affords an opportunity of examining this theory from a botanical standpoint. For the purposes of the 'Botany' of the *Challenger* Expedition, and ever since that publication of this work, I have collected all the data coming under my notice bearing on the dispersal of plants to considerable distances by wind, water, birds or other creatures, excepting human. The evidence thus collected sufficiently accounts for the vegetation of low coral islands, and the littoral vegetation of widely separated countries; but it in no way helps to explain the vegetation of the enormously distant islands of the Anarctic seas, for example, or that of the islands of the Galápagos group, to give another instance.

" But these are not parallel cases; they are the two extremes in the amount of differentiation in connection with isolation.

" The biological phenomena of the Galápagos Islands left a deeper impression, probably, on the mind of Darwin than those of any other part of the world he visited, and doubtless had

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the theory of subsidence, and I found that it did not. *Professor Agassiz did not refer with one word to this harmony of distribution, which formed the basis of my whole ideas.* When Professor Agassiz, or any one else, is able to explain this by the elevation theory, I shall be the first one to adopt it. But, until this has been done, I believe in subsidence. The paper to which Professor Agassiz refers was written before my visit to the islands. My investigations have only more convinced me of the insufficiency of the elevation theory."

[10] Hemsley, W. Botting. The Flora of the Galápagos Islands. Nature, Vol. 52, No. 1356, October 24, 1895, p. 623.

much to do with his later conception of the origin of species. The fact on which he laid special stress was that the genera, to a very great extent, were the same as in all the islands, and the species different in each island. Dr. Baur's much more extensive zoological and botanical collections and observations confirm and emphasize the correctness of the view of his illustrious predecessor of fifty years ago. Darwin especially refers to the existence of different species or races of tortoises and mocking-thrushes [*Nesomimus*] in many of the islands; and Baur's examination of the lizards of the genus *Tropidurus*, from twelve of the islands, reveals the same condition of things. The botanists bring forward *Euplorbia viminea* in illustration of this phenomenon. This species was described by Sir Joseph Hooker from a single specimen collected by Macrae in Albemarle Island, and the author remarks that he "knew of no species with which to compare this highly curious one." Dr. Baur collected it extensively in eight of the islands, and the specimens from almost every one of them [7] exhibit distinct racial characteristics. *Acalaphe*, a genus of the same natural order, presents somewhat more pronounced variation in the different islands, which some botanists regard as of specific value; other botanists, as of varietal value only. Whatever status we give these forms, the flora as a whole is a most instructive and convincing illustration of evolution.

"A remarkable peculiarity of the Galápagos flora as an insular flora is the almost total absence of endemic genera, for the two or three genera of the Compositæ restricted to the islands are so closely allied to the American genera as hardly to count as distinct. Indeed, the whole flora is so thoroughly American that, apart from geological difficulties, it might be regarded as a differentiated remnant thereof, rather than derived therefrom, after the supposed elevation of the islands. Analogous conditions and phenomena are repeated in the deep valleys of the great mountain chains of northern India and western China, where, in neighboring valleys, the genera are to a great extent the same and the species different.

"Looking at the composition of the Galápagos flora, especially with an eye to the probabilities of the transport of the seeds of its constituents, combined with present conditions, Dr. Baur's theory seems deserving of more serious consideration than it has hitherto received. My slender knowledge of geology alone prevents me from taking up a more decided position."

The last communication of Hemsley[11] appeared in the June number of *Sciencc Progress*, 1896. He writes: "When reviewing the newer literature relating to the flora of the Galápagos Islands I found little to add to what had been done by Darwin, Hooker and Anderson; merely mentioning the visit of the United States ship *Albatross*, and Dr. Baur's theory of the origin of the fauna and flora. Since then an account of Dr. Baur's botanical collections has been published, and the substance has also appeared in an English journal, and Dr. Baur himself has written and lectured in defense of his theory of the origin of this group of islands. As previously stated, he contends that the evidence points to the present condition being the result of subsidence, that the islands were formerly connected with each other, and at a still earlier period with continental America. Although this theory has been derided, I think the biological data strongly favor its correctness; and the soundings given in the map accompanying Agassiz's report of the *Albatross* expedition show a relatively shallow area in which the Galápagos Islands are situated, and which extends eastward to the mainland of Veragua. Probably the segregation would be greatly anterior to the segregation of the West Indian Islands."

It is seen that the subsidence theory has won very extensive ground, in fact, there are only very few opponents left which in the future might be converted. Besides Agassiz, whom I have mentioned before, Stearns, Dall and Wolff. Dr. Stearns[12] had only seen my paper published in the AMERICAN NATURALIST (March, April, 1891), before my visit to the Galápagos. He believes in the elevation theory and the accidental importation of the fauna and flora by currents.

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[11] Hemsley, W. Botting. Insular Floras. Part VI. Science Progress, Vol. V, No. 28, June, 1896, p. 298–302.

[12] Stearns, Robert E. C., Ph.D. Report on the Mollusk-Fauna of the Galápagos Islands, with Descriptions of New Species. Proc. U. S. Nat. Mus., Vol. XVI, p. 353–450, Pl. LI–LII, Washington, 1893.

W. H. Dall,[13] who has written the most extensive work on the landshells of the Galapagos Islands, also adopts the accidental introduction of the fauna. He says, p. 403: "Omitting the *Auriculidæ* and *Siphonariidæ*, we have, as supposed, peculiar forms in each group of islands: twenty-one characteristic of the southeastern, fourteen from the central, and one from the northeastern group of islands, which agree well with the hypothesis that the species originated with forms brought by winds and currents which impinge first on the southeastern group.

On the other hand, it is certain that the southeastern islands are much better known than either of the other groups, and that the area and fertility of the central group are such that there is every reason to suppose many more forms remain to be discovered there, perhaps, including some of those so far known only from the southeastern islands. Prudence strongly urges, that we know too little of the mollusk fauna yet to intelligibly discuss its inter-island distribution."

If the seeds of the different forms of *Euphorbia viminea* Hook. fil. are not blown or floated from one island to the other, as we have seen above, I cannot imagine that the landshells have been transported from island to island, or even from the American continent. Why ought these animals form an exception from the other ones?

Dr. Th. Wolf[14] does not agree at all with the subsidence theory. He says: "Every geologist will stand up against Dr. Baur's hypothesis, until he shall have proved that it is absolutely indispensable for the explanation of the organic creation (organische Schōpfung) of the islands. The answering of the question: How have the present species of animals and plants been developed from the immigrated (or, according to Baur, the remaining) South American[15] species? is very difficult. Here opens, of course, an enormous field for speculation, and, as long as the opinions on the fundamental causes of the origin of species are so different, as to-day, the attempted explanations will be different. *Non nostrum inter vos tantas componere lites.*"

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[13] Dall, William Heally. Insular Landshell Faunas, Especially as Illustrated by the Data Obtained by Dr. G. Baur in the Galápagos Islands. Introductory. Proc. Acad. Nat. Sci.. Philadelphia, August, 1896, p. 395–459, Pl. XV–XVII.

[14] Wolf, Dr. Th. Die Galápagos-Inseln. Verhandl. Ges. Erdkunde. Berlin, Bd. XXII, 1895, No. 4 u. 5. Berlin, 1895, p. 246–265, Taf. 3.

[15] I never said that they came from South America.

Mr. Ridgway[16] does not reach a definite conclusion about the origin of the Galápagos, but he says: "If the apparent relationships of the fauna have any bearing on the question, I believe Dr. Baur's theory to be at least worthy of serious consideration."

In regard to the question of relationship of the six peculiar genera of the Galápagos, Ridgway reaches the following conclusion. Only two (*Nesomimus* and *Nesopelia*) are of evident American relationship. The remaining 3 [4] have so obvious a leaning toward certain Hawaiian Dicæidine forms that the possibility of a former land connection, either continuous or by means of intermediate islands as 'stepping stones,' becomes a factor in the problem. It may be that the resemblance of *Cocornis*, '*Cactornis*,' and *Camarhynchus*, to the above-mentioned Hawaiian forms (*Lorioides*, *Telespiza* and *Psittirostra*) is merely a superficial one, and not indicative of real relationship. I do not by any means claim, on the strength of such evidence, a common origin for them, but merely present the facts as 'food for reflection.' *Certhidea* is also compared with Hawaiian genus *Oreomyza*, of the chiefly Polynesian family *Dicæidæ*.

Since there is no relation whatever of the Galápagos fauna and flora as a whole to fauna and flora of the Hawaiian Islands, the similarities between these birds are certainly only superficial. A former connection between the Galápagos and the Hawaiian Islands is entirely out of the question, these two archipelagos are 7350 miles distant from each other, there is not a single island placed between them, and the intervening sea is 4000 meters deep.

For the opponents of the subsidence theory I give now a few striking examples of continental islands.

The *Solomon Islands* are connected by the 2000 m. line with New Guinea and the New Hebrides. The Solomon Islands possess 12 species of Amphibia.[17]

[16] Ridgway, Robert. Birds of the Galápagos Archipelago. Proc. U. S. Nat. Mus., Vol. XIX, p. 465–467. Washington, 1896 [published April 1, 1897].

[17] Boulenger, G. A. On the Reptiles and Batrachians of the Solomon Islands. Trans. Zool. Soc. London, Vol. XII, part I, April, 1886, p. 47–62, pl. VIII–XIII. Second Contribution to the Herpetology of the Solomon Islands. Proc. Zool. Soc., 1887, II, p. 333–338.

The family *Ceratobatrachidæ* Boulenger with *Ceratobatrachus günteri* Boul. is only found there. The other species are:

Ranidæ.

Rana bufoniformis Boul., nearest to *Rana kuhlii* (Schleg.) Dum. and Bibr. from the Indian Archipelago (Java, Borneo, Celebes), S. China.

Rana guppyi Boul., as large as the bull-frog, nearest to *Rana gruniens* Daud., Amboyna and Java.

Rana opisthodon Boul., near *R. guppyi* Boul. and *R. gruniens* Daud. This form develops in the egg without metamorphosis, like *Hylodes martinicensis* Tschudi.

Rana krefftii Boul., related to *R. erytraea* Schleg., from the East Indian Archipelago and the Malayan Peninsula.

Cornufer dorsalis A. Dum., also found on the Fiji Islands.

Cornufer guppyi Boul., related to *C. dorsalis* A. Dum.

Cornufer solomonis Boul., near *C. corrugatus* A. Dum., from New Guinea and Duke of York I.

Batrachylodes vertebralis Boul., only known from the Solomon Islands.

Hylidæ.

Hyla macropus Boul.

Hyla thesaurensis Peters.

Hyla lutea Boul.

The presence of this peculiar Batrachian fauna on the Solomon Islands would be sufficient proof for their continental origin, but this is also shown by the geology of the group.[18] There have been found granitoid porphyrites, serpentines and old sedimentary rocks represented by quartzites and crystalline schists.

New Caledonia is surrounded by a deep sea of 2000–4000 m., but it is a typical continental island, as is shown by the geology.[19] There are extensive primitive schists, gneiss and other crystalline rocks, and the Triassic and Cretaceous cover extensive areas.

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[18] Guppy, H. B. The Solomon Islands, their Geology, General Features and Suitability for Colonization. London, 1887.

[19] Bernard, Augustin. L'Archipel de la Nouvelle-Calédonie. Paris. Hachette et Cie, 1895, p. XXIV, 458. Deux cartes et beaucoup de figures. This is a very important work, not only for the geology of New Caledonia, but for the whole western region of the Pacific Ocean.

The *Fiji Islands* are even more isolated, being surrounded by a sea of 2000–4000 m. South of this group the soundings show 4000–6000 m.,and east from the Tonga Islands even 6000–8000 m. But on the Fiji Islands we find three species of frogs: *Cornufer dorsalis* A. Dum., only known from the Solomon Islands, besides two peculiar species, *Cornufer vitianus* A. Dum. and *C. unilineatus* Peters.

The genus *Cornufer* Tschudi shows the following interesting distribution (Boulenger: Catalogue Batrachia Salientia s. Ecaudata, London, 1887, p. 107–111).

1. *Cornufer unicolor* Tschudi. New Guinea.
2. *Cornufer guentheri* Boul. Philippines.
3. *Cornufer mayeri* Günth. Philippines.
4. *Cornufer jagorii* Peters. Samar Island.
5. *Cornufer corrugatus* A. Dum. Philippines, New Guinea, Duke of York Island.
6. *Cornufer punctatus* Peters & Doria. New Guinea.
7. *Cornufer guppyi* Boul. Solomon Islands.
8. *Cornufur solomonis* Boul. Solomon Islands.
9. *Cornufer dorsalis* A. Dum. Solomon and Fiji Islands.
10. *Cornufer vitianus* A. Dum. Fiji Islands.
11. *Cornufer unilineatus* Peters. Great Viti Island (Fiji I.).

A still more peculiar fact is the presence of a very large Iguanoid Lizard *Brachylophus fasciatus* (Brongn.), also found on the Friendly Islands. The nearest relatives of *Brachylophus* Cuv. are *Conolophus* Fitz. and *Amblyrhynchus* Bell from the Galapagos; *Iguana* Laur., Tropical America; *Metopoceras* Wagler, San Domingo; *Cyclura* Harlan,West Indies (Cuba, Jamaica, Bahamas); and *Ctenosaura* Wiegm., Central America.

Of the 50 genera of *Iguanidæ* 47, with over 300 species, are American; two genera, *Chalarodon* Peters, with a single species, and *Hoplurus* Cuv., with three species, are found in Madagascar. This is certainly a very interesting case of distribution.

The genus *Enygrus* Wagler, a snake of the family *Boidæ* (Subfamily *Boinæ*) is represented by four species, which show the following distribution:[20]

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[20] Boulenger, George Albert. Catalogue of the Snakes in the British Museum. (Nat. Hist.) Vol. I, p. 104–109, 1893.

1. *Enygrus bibronii* Hombr. & Jacq. Fiji, Friendly or Tonga and Solomon Islands (San Cristoval).

2. *Enygrus australis* Montrouzier. New Britain, Solomon Islands, New Hebrides, Loyality Islands, Samoa.

3. *Enygrus carinatus* Schneid. Pelew Islands, Ternate, Ceram, Amboyna, Timor Laut, Misol, New Guinea, Louisiade Archipelago, Duke of York Island, Solomon Islands.

4. *Enygrus asper* Günth. Misol, Salavatti, New Guinea, and Duke of York Island.

The presence of *Cornufer*, *Brachylophus* and *Enygrus* can only be explained by the continental origin of the Fiji Islands. Here, also, the geological proof has been given.[21]

In 1862 and 1865 the Fiji Islands were visited by Graeffe, and from 1876–78 by Th. Kleinschmidt, sent there by the Museum Godeffroy in Hamburg. Gräffe collected rocks on Viti Levu and on some small islands belonging to the Exploring Islands; Kleinschmidt on Viti Levu, Kandavu, Ono, Vatu Lele and Ovalau. The material has been worked up by Arthur Wichmann.[22]

The most important result reached by the examination of the Kleinschmidt-collection consists in the demonstration of the existence on the Fiji Islands (Viti Levu) of old crystalline massive rocks and crystalline schists in considerable extension. The following rocks belonging to the chrystalline schists have been found: Amphibolites, Eurites, Quartz-mika-schists, granular Limestone. Of the most important older massive rocks occur Granite, Quartz Porphyry, Diorite, Gabbro, Diabase, Foyaite, and a Sandstone similar to Itacolumit. These rocks have been found partially *in situ*, partially they have been picked up from the beds of different brooks and rivers. No trace of paleozoic and mesozoic strata have been discovered. The youngest massive rocks are represented only by Andesites and Basalts, the former very much more developed. Their tuffs and conglomerates are often fossiliferous, and form the superficial cover. These fossils are of Tertiary age, and certainly not older than Miocene. Of minerals: gold, copper, quartz, pyrite, hæmatite and others were found. All the other islands visited by Kleinschmidt, Kandavu, Ovalau, Ono, Vatu Lele and the Munia, Kanathia, Vanuna-Bulavu of the Exploring Islands, on which Gräffe collected, consist nearly entirely of Andesites and Basalts and their tuffs. In some, for instance, Ono, Vatu Lele, coral-rocks and silicified corals occur.

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[21] I have reached the conclusion about the continental origin of the Fiji Islands before I knew of the geological proof by Wichmann. This paper I saw for the first time in June of this year in the Crerar Library.

[22] Wichmann, Arthur. Ein Beitrag zür Petrographie des Viti-Archipels. Mineralog. und Petragraph. Mittheilungen: herausgeg. von G. Tschermak. (Neue Folge) 5. Band Wien, 1883, p. 1–60.

If we compare the results found on the Fiji Islands with the geological conditions of other islands of the Pacific Ocean, we partly observe very surprising similarity. A very short time ago it was considered as certain, and generally accepted, that all islands of the Pacific Ocean originated through volcanic activity. As exceptions were named New Zealand and New Caledonia. The investigations of the last years have brought forward more light about several of these conditions. Drasche, in 1879 (Neues Jahrb. Min. Geol., 1879, p. 265), stated that only those groups of islands placed eastwards from a line extending from Kamtschatka over Japan, the Philippines, New Guinea, New Caledonia, New Zealand, Auckland, Macquarie to Arctic Victoria, are either coral islands, or consist of young volcanic rocks.

Outside of this line there are, besides the Fiji Islands, some other groups. From the *Pelew Islands* Wichmann described large blocks of a very coarse-grained hornblende-granite and diabase, found at the seashore and at elevations of 400 m. [Journal des Museum Godeffroy, 1875, VIII, p. 126.] Marcou has reported granite and gneiss from the *Marquesas Islands*, and Eichwald[23] has shown that the Aleutian Islands contain Cretaceous strata.

Wichmann makes the following remarks at the end of his paper: "No older massive rocks or sedimentary strata are known from the other "volcanic" groups of islands of the Pacific Ocean, and on some of these, for example, the Galápapos or Sandwich Islands, it seems really to be made out that they have been built up by younger and recent volcanic masses. There is a possibility, and even probability, however, that older formations served as fundament, the examination of which is prevented by the extensive covering."

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[23] Eichwald, E. Geognostisch-palæntologische Bemerkungen über die Halbinsel Magischlak und die Aleutischen Inseln. St. Petersburg, 1871.

From the facts mentioned, it follows that these islands in the Pacific, which, so far as known, are merely of volcanic origin, are not of much significance. Besides, various extensive regions have been terra firma during long periods. On the groups of islands which extend from the Philippines to the Fiji Islands, all marine sediments are missing up to the upper Cretaceous (New Britain), on the others even up to the Miocene. It is remarkable that the northern islands (Japan) and the southern (New Zealand) show the different formations very much more developed. A complete representation of the strata is not found in a single group of islands, therefore, we can suppose that they, together with portions of the ocean, formerly represented continental masses. Thus, it becomes probable, that the Pacific Ocean cannot be considered of great age, that it received approximately its present form only during the time of the younger Tertiary (Wichmann).

From the peculiar fauna of the Fiji Islands we reached the conclusion that they must be of continental origin. The correctness of this conclusion follows from Wichmann's petrographical studies of the rocks.[24]

For the Galápagos Islands the correct geological proof cannot be given, but the harmonic distribution of fauna and flora can only be explained by their continental origin. The connection must have been with Central America and the West Indies over Cocos Island. There are no geological difficulties, since we know that the Fiji Islands, which are surrounded by much deeper sea, are continental.

It is evident that the theory of the consistency of continents and oceans since palæozoic times, or ever before, must be abandoned completely. Edward Suess,[25] in his masterly work, "Das Antlitz der Erde," has fully demonstrated the fallacy of this theory. If Dr. Alfred Russel Wallace[26] would have studied this work and those of W. T. Blanford, O. Feistmantel, W. Waagen, Melchior Neumayer, and others, he could not have accepted the theory of the permanence of the great oceanic basins, which he still defends in 1892, quoting the late Prof. Dana, Mr. Darwin, Sir Archibald Geikie, Dr. John Murray, Rev. O. Fisher and himself as authorities, not mentioning any of the names just given.

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[24] Only by this theory many very peculiar cases of distribution in the Pacific Region and the presence of Pacific and Asiatic forms on the coast of America can be explained.

[25] Suess, Eduard. Das Antlitz der Erde. 2. Bände Wien, 1885–88. Band I. Zweite unveränderte Auflage Wien, 1892.

We know now that there existed a *Lemuria* or *Gondwana Land*, an *Antarctic Continent*,[27] which extended to India, South Africa, South America, and that the Pacific Ocean has not been an ocean since palæozoic or archæan times, but is probably even of recent (Tertiary) date.

In order to reach correct conclusions about these often very complicated questions, it is necessary to use all the data offered by modern geographical and palæontological distribution of fauna and of flora geology.

(*To be Continued.*)

ON THE AFFINITIES OF TARSIUS: A CONTRIBUTION TO THE PHYLOGENY OF THE PRIMATES.

By Charles Earle.

(*Continued from page 575.*)

The female reproductive system of the Lemurs recalls that of the Anthropoids. It is interesting to note that in *Lemur Propithecus* and *Indris* only one young is produced at a birth; whether this number of young is typical of the whole suborder of *Lemuroidea* I am unable to discover. The form of the uterus exhibits considerable variation in the Lemurs. Milne-Edwards says: "L'Uterus des Indrisines a la forme d'une poche median dont le fond est bicorne les deux lobes ainsi constitués sont tres peu saillants chez les Propithiques et les Avahis, ils le sont davantage chez l'Indris." In *Propithecus* especially, the cornua are extremely reduced, and externally the uterus has the appearance of the uterus simplex of the Anthropoids. In the gravid uterus, owing to the extremely small size of the cornua, the single fœtus occupies one horn and all the body of the uterus; in *Lemur* the non-gravid cornua is occupied as shown by Turner by a prolongation of the chorion. It is not difficult to imagine the derivation of the uterus of the Apes from the condition found in the higher Lemurs, further constriction of the fallopian tubes of *Propithecus* and obliteration of the slight septum dividing the rudimentary cornua of this genus would produce the pure type of uterus simplex found in the Apes.

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[26] Wallace, Dr. A. Russel. The Permanence of the Great Oceanic Basins. Nat. Science, Vol. I, No. 6, August, 1892, p. 418–426; and "Island Life," second ed., 1892.

[27] Seward, A. C. The Glossopteris Flora. Science Progress, New Series, Vol. I, No. 2, January, 1897, p. 178–201. (This paper gives the Bibliography relating to the Anarctic continent.)

I will now pass on to consider the palæontological history of the Primates and the conclusion which may be drawn from it. Prof. Hubrecht claims that throughout the whole Tertiary period the Lemurs and Apes were perfectly distinct, and, moreover, he concludes that we must go as far back as the Mesozoic to find the two stem forms of these suborders. I hold there is absolutely no palæontological evidence to support this deduction, and all our knowledge of the fossil Primates show that the Apes have arisen later than the Lemurs. Prof. Hubrecht, following Ameghino, refers the Santa Cruz formation, in which *Homunculus* occurs, to the Eocene. All palæontologists now admit that the Santa Cruz beds are of much later date than the Eocene, and it appears probable that they are not earlier than the Lower Miocene. If there is anything in the biological law that less specialized forms originate earlier than the more modernized types, it is surely applicable to the Primates where every one must acknowledge that an Ape is a much more highly differentiated organism than a Lemur.

I will not consider the so-called Primates from the lowermost Eocene, Puerco. We know little about these forms, but, as far as our knowledge goes, such genera as *Indrodon* and

Mixodectes appear to be related to the Lemurs, but in the case of *Indrodon* the shape of the external cusps of the superior molars are not at all *lemurine*, and resemble more those of the *Cheiroptera*.

The Wasatch genus, *Anaptomorphus*, has been placed by Hubrecht with Tarsius, among the Apes and for what reason? It certainly has only one Anthropoid character, the presence of an internal lobe to the third upper premolar. If *Anaptomorphus* is an Ape, then I claim that this is absolute evidence that the Apes have come from the Lemurs, for *Anaptomorphus* is in all of its characters a Lemur closely related to *Tarsius*. However, *Anaptomorphus* is an important type in connection with the phylogeny of some of the Anthropoids, and may have given origin to the American Monkeys, these latter having arisen independently from the Old World Apes. Numerous peculiarities in the structure of the *Cebidæ* as compared with the *Cercopithecidæ* support this view. Excepting *Anaptomorphus* it appears probable that none of American fossil lemurines can be considered as ancestral to either the recent Lemurs or Apes.

In the Oligocene of France the primitive Lemurs were very abundant, and they were represented by numerous genera other than the well-known *Adapis* and *Microchoerus*. Consequently, as far as we know, the recent Lemurs must have been derived from some of the genera now found as fossils in Northern Europe. Mr. Lydekker is of the opinion that Apes occur in the Oligocene of France, but I have not been able to find any evidence for this view, as most of the supposed Apes from the Phosphorites have been shown to be Suillines. The structure of the upper molars of *Adapis* is very similar to that of recent Lemurs, the external lobes being lenticular in section as in recent forms, the protocone is placed well forward and the hypocone is more primitive than in many of the *Lemurinæ*. As far as I have examined, all recent genera of the subfamily *Lemurinæ* have tritubercular superior molars with varying development of the supplementary internal cusps. In the *Indrisinæ* the molars are truly quadritubercular and the internal cusps are nearly selenoid in structure. It is strange that among American Monkeys, *Mycetes* has a type of superior molar which closely resembles that of the *Indrisinæ*, whereas, in the other *Cebidæ*, the upper back teeth are transitional in structure, between the tri- and quadritubercular types, and the cusps are bunoid. The molar pattern of recent Lemurs and Old World Apes is fundamentally different, but they may be brought into closer relations by means of the primitive structure of the molars of *Tarsius* or *Anaptomorphus.* If *Tarsius* stands near the common ancestor of both Apes and Lemurs, then we must suppose that the teeth of the two phyla of recent Primates have increased in complexity during geological time. Nevertheless, in the Anthropoid Apes the molar pattern shows plainly a process of degeneration from a higher type, more like that found in the *Cercopithecidæ.*

Until recently no known Primate, fossil or recent, possessed a closed orbit as in the Apes and proclivous incisors and caniniform first lower premolar as in the Lemurs. This combination of characters is found in the Malagasy fossil lately described by Forsyth Major under the name of *Nesopithecus.* The skull, as far as known in *Nesopithecus,* is broad and short like that of the Apes, and as in the latter group the lachrymal foramen is within the orbit. Again, the structure of the true molars is exactly like that of the Anthropoids. On the other hand the form of the premolars is more like that of the Lemurs, and, as far as I can learn from Major's figures, all the upper premolars have small internal lobes. The incisors of *Nesopithecus* are not preserved, but from the oblique position of their alveolii Major concludes that these teeth must have been horizontal as in the living Lemurs. Moreover, as in the latter group, the first lower premolar functions as a canine. The collection of characters occurring in *Nesopithecus* completely breaks down the differential characters of the skeleton which is usually given as separating the Lemurs from the Apes. Either these two groups should be united, or *Nesopithecus* must be placed in a new suborder of the Primates. It remains now to consider whether *Nesopithecus* clears up the problem of the relation of the Lemurs to the Apes. Lydekker is of the opinion that *Nesopithecus* is a form closely related to the stem type which gave origin to both Lemurs and Apes. For my part, I do not think that this explanation is probable, and for the reason that no primitive ancestor of the Primates would have had a closed orbit and proclivous lower incisors. At the time the Apes and Lemurs diverged from a common stock, this stem form would have had characters more like those of the *Adapis*, and not until very late, geologically speaking, were the peculiar incisors of the Lemurs developed. Primates with closed orbits do not appear until the Middle Miocene. We are then forced to the conclusion that one set of characters of *Nesopithecus* is due to convergence. As *Nesopithecus* has so many peculiar characters only found in the Anthropoids, including the structure of the true molars, I conclude with Major that *Nesopithecus* is really an Anthropoid whose anterior dentition through convergence has come to resemble that of the Lemurs. Lastly I do hold that the discovery of *Nesopithecus* demonstrates that Apes and Lemurs are genetically related.

The characters of the skeleton of *Tarsius* are nearly all those of the Lemurs; the extreme specialization of the pes of *Tarsius* is clearly a lemurine character, and we can observe how this elongation of the tarsus is produced. In *Lepidolemur* the elongation of the calcaneum and navicular commences, the extension of these bones is carried still further in *Cheirogaleus*, and reaches its culmination in *Tarsius*. Of course this is not a phyletic series, and I merely mention it to show how the elongation of the tarsus in *Tarsius* is developed, and from a more normal condition found in the typical Lemurs. *Tarsius* differs from most of the Lemuroidea in not having the fourth digit of the manus longer than the others, the extension of this digit attains its greatest development in the most specialized group of the Lemurs, the *Indrisinæ*. The Indrisines are clearly the most highly differentiated division of the Lemurs; this is shown in their more highly developed brains, reduction in the length of the facial as compared to the cranial axis of the skull, the pseudo-selenoid superior molars, and lastly the great length of the posterior limbs in contrast with the anterior members. In this connection it is interesting to note that the *Indrisines* are diurnal in their habits like most Apes, and that in *Indris* the caudal appendage is much reduced in size.

Forbes pointed out the important fact that the structure of the orbit in the Old and New World Apes differs; in most of the *Cebidæ* there is a large articulation between the malar and parietal, the broad plate-like alisphenoid is limited to the inferior portion. In the *Cercopithecidæ* the alisphenoid is narrow and prolonged above to the frontal, so as to separate the malar-parietal contact. In the structure of its orbis *Tarsius* more resembles the Old World Apes, for the alisphenoid articulates with both malar and frontal as in the *Cercopithecidæ.* The structure of the skull of *Tarsius* is of importance as showing how the closure of the orbit of the Apes is brought about. It is evident that the relations of the orbital bones found in the *Cebidæ* is the primitive one, the broad and inferiorly placed alisphenoid is characteristic of the lower orders of Mammals, as the Rodents and Carniverous Marsupials. Coincident with the increase in breadth of the frontal lobes of the cerebrum of *Tarsius* as compared to other Lemurs, has taken place a reduction of the facial portion of the skull, and with it the near approach of the lachrymal foramen to the orbital border. *Nesopithecus* represents another step in the evolution of the skull of the Apes from that of the Lemurs, as in this form the facial axis is still more reduced, and at the same time the lachrymal foramen has been taken within the orbit. In *Nesopithecus* the orbits are directed forwards as in the Apes, and Forsyth Major concludes from the broken condition of the posterior orbital wall, that this genus had a completely closed orbit. The skull of *Tarsius* represents a stage in the evolution of the Primate cranium exactly intermediate between that of the Apes and Lemurs. Among the typical Lemurs the general form of the cranium in the *Indrisinæ* is closely similar to that of *Tarsius.*

Although the structure of the molars in *Tarsius* is very primitive, and may represent the ancestral pattern from which that of the Lemurs and Apes has been derived, this cannot be claimed for the anterior part of the dentition. The reduction in size of the canines in *Tarsius* and the enlarged upper median incisors is certainly a case of specialization. We see this same change in the *Insectivora,* and Flower concludes: "The strongly marked distinction of the canines from the incisors and anterior premolars in the Mesozoic and most of the Tertiary Mammals (excepting some Ungulates) points, however, very decidedly to the conclusion that the want of definition between these teeth in many of the modern *Insectivora* is an acquired feature." I quote this passage from Flower and Lydekker, because an important paper by Leche has lately appeared in which he claims that the milk teeth represent an earlier development phase than the permanent teeth. He arrives at this generalization from a study of the milk dentition of the Lemurs, including *Tarsius.* Leche finds, for example, that in the anterior milk dentition of *Adapis magnus* the milk canines are much reduced in size, and more resemble the form of the premolars, and he also points out that the deciduous dentition of this species of *Adapis* very closely resembles the permanent condition of *Adapis parisiensis.* Leche concludes, therefore, that *A. parisiensis* represents the most primitive and ancestral form of *Adapis* known, and that the Ape-like form of the incisors and canines of *A. magnus* is a secondary condition derived from that of *Adapis parisiensis.* I feel confident that palæontologists will not accept this dictum in regard to the significance of the milk dentition as expounded by Leche. I should like to notice one point that seems to contradict this general law as deduced by Leche. In *Tarsius,* for example, Leche's figures plainly show that the upper milk canine is larger than either of the milk incisors or the anterior premolars. If the structure of the anterior milk teeth is to be our guide in determining the evolution of the Lemurs, then *Tarsius* has come from a type which had large canines and in which these teeth were erect and of greater size than either the incisors or premolars. This conclusion corresponds better with the palæontological record.

One of the best examples of extreme specialization and reduction in the size of the canines is the case of the *Anoplotheridæ,* an extinct family of Artiodactyle Ungulates. In this group the dentition is closed and the canines are of the same size and structure as the anterior premolars. I am sure that no palæontologists will claim that the dentition of the *Anoplotheridæ* is primitive, as the whole structure of this family denotes that it is an exceedingly specialized group. I have endeavored to show elsewhere that *Tapirulus* is probably genetically related to the Anoplotheroids, and in this genus the canines are fully developed. As far as I can learn it is a general character of the milk dentition that the milk canines are weakly developed and much smaller than their permanent successors. It appears more likely that the milk dentition represents a special adaption during the time that the young animal is nourished by the mammary glands of the mother, and that the detailed structure of the milk teeth do not accurately recapitulate the ancestral stages in the evolution of the race. However, in regard to the number of the milk teeth, that is another question, for we know that in many types which in the adult condition the permanent teeth are greatly reduced in number, whereas in the milk series the lost teeth appear. Among Lemurs *Cheiromys* is a good example in the reduction of the teeth, where the milk dentition is more normal in regard to the number of teeth than the permanent dentition, and plainly shows that *Cheiromys* has been derived from some more generalized type of Lemur, which had the normal number of incisors and premolars.

In conclusion, the two principal objections in claiming that the Lemurs are genetically related to the Apes are, first, in the apparently great difference in their placentation, and secondly, in the wide divergence in the structure of their dentition. In regard to the evolution of the placenta, Dr. Minot remarks that our conceptions are still very obscure. The views of Balfour which I have lately quoted[2] as to placental evolution in the Primates are clearly untenable, for the reason, as I have emphasized before, that in the Apes the allantois is rudimentary and the placenta arises in the chorion. It is most important for the position which I maintain in regard to the relations of the Lemurs to the Apes, to notice that in the early stages of the development of the placenta in the Anthropoids that this organ is completely diffuse and there is no decidua. This stage is comparable to the diffuse placentation of the Lemurs. On any theory of the evolution of the placenta in the Primates we must first commence with the non-deciduate diffuse condition as found in Man, the later restriction of the placental area brings about complications in the relations of the maternal to the fœtal surfaces, resulting in the formation of a decidua. Hubrecht himself admits that *Tarsius* is very specialized in not exhibiting in its early stages the diffuse condition of the placenta found in the Anthropoids. It seems to me that it is a most difficult problem to attempt to derive the type of placentation of the Apes from that of *Erinaceus.* In the latter genus the placenta is derived from the allantois, which is a large free organ before it unites with the chorion. Then, again, in *Erinaceus* there is no early stage where the mesoblast lines the whole blastocyst as in *Tarsius*, and a portion of which membrane takes a share in the formation of the placental anlage. The *Insectivora*, however primitive they are in many respects, are greatly specialized in their dentition and placentation.

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[2] See Natural Science, May 1897.

Huxley remarks: "If *Gymnura* possessed a diffuse placentation, it would be an excellent representative of an undifferentiated Eutherian." Again, he says: "The derivation of all Eutheria from animals which, except for their placentation, would be insectiverous, is a simple deduction from the law of evolution." That some *Insectivora* are highly degenerate in their cranial and dental structures, I think must be admitted. I refer particularly to *Hemicentetes*, whose supposed primitive type of molars is clearly a case of degeneration from the more normal form of tooth occurring in *Centetes.*

Until it is disproved by further investigations on the early stages of Lemurs, I think it is most plausible to assume that the diffuse placenta of the Lemuroidea is one of the ancestral stages in the evolution of the Anthropoid placentation, and in the case of Man this diffuse non-deciduate stage is recapitulated in the ontogeny of *Homo.*

As far as the palæontological evidence goes it is decidedly in favor of the view that Apes and Lemurs are closely related. Beginning with the earliest known Lemur, *Anaptomorphus*, this genus shows tendencies towards the Anthropoids, and when we pass up into the Oligocene of the Old World, *Adapis* is a decidedly mixed type, and probably not far from the common stem form, which gave origin to both suborders of the Primates.

In regard to *Tarsius*, it is evidently a type nearly between the Lemurs and Apes, but with many essential characters belonging to the former group. Some of its Anthropoid characters are nascent, so to speak; they are just developing, and, as in the case of the orbit of *Tarsius*, it is not yet fully differentiated into the higher type of the true Anthropoids. It appears most likely that the group of fossil Lemurs with reduced canines and enlarged incisors, *Mixodectes*, *Microchœrus*, were not in the line leading to the Lemurs proper, but may have been related to *Cheiromys*. These genera in their turn arose out of a generalized insectiverous-like type with a normal dentition, which was also the ancestral form of the true Lemurs. The Anthropoids diverged from a lemurine stock probably not earlier than the Upper Eocene. This deduction is supported by the fact that the first Lemurs to appear are insectivorous in their affinities; later, in the Upper Eocene, Lemurs are found with quite Ape-like skulls and dentition, and, moreover, not until the Miocene do true Anthropoids appear.

I shall conclude this paper with a quotation from a Memoir of Sir Wm. Turner's, whose extensive investigations on the placentation of Mammals are well known to all morphologists: "In the case of the Lemurs it will, I think, be considered by most zoologists that the characters of the teeth, the general configuration of the skeleton, the unguiculate digits, the hand-like form of the distal part of the extremities, the presence of a calcarine fissure in the cerebrum and the pectoral position of at least two of the mammæ, are characters which indicate that the Lemurs have much closer affinity with those mammalian orders with which it has been customary to associate them, than with the Perissodactyla, Suina and Cetacea. Collectively, these characters ought, I think, to be regarded as more valuable indications of structural affinity than should the presence in the Lemurs of a non-deciduate diffused placenta with a large allantois be regarded as indications of structural dissimilarity from the Apes and Insectivora, though the placenta in the latter is deciduate and discoid and the allantois aborted."

THE SWAMPS OF OSWEGO COUNTY, N. Y., AND THEIR FLORA.

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POSITION OF OSWEGO COUNTY.

Oswego County lies in the extreme northeastern corner of the Finger Lake Basin of central New York. Lake Ontario makes, at this point, a great bend to the north after having its shore line almost due east and west for upwards of one hundred and fifty miles. The lake consequently forms the northern and a large part of the western boundary of the county. On the northeast are the foot-hills of the Adirondacks, some of which extend into the corner of the county. On the southeast is Oneida Lake and Oneida River, which occupy the lowest part of the general basin toward its eastern end, and south of which lie the hills forming the divide between this and the Susquehanna Basin. On the southwest there are no physical boundaries separating this county from adjoining ones. The county is part of the plain which extends west and southwest through several counties, the lowest points in which are occupied by Onondaga Lake, Seneca River, the Montezuma Marshes and Cayuga Lake. The plain narrows rather abruptly to the southeast and leads over a very low divide into the valley of the Mohawk River. A comparatively narrow plain follows the lake shore north through Jefferson County.

DRAINAGE SYSTEM OF THE COUNTY.

The present drainage of Oswego County is peculiar. Oswego River, flowing as it does directly through the county, would naturally be expected to receive a considerable amount of the drainage. It, however, receives very little. A low divide extends from east to west through the central and western parts of the county, the summit of which is about halfway between the north shore of Oneida Lake and the south shore of Lake Ontario. The summit of this divide is well-marked east of the river and extends through Fulton and Palermo center. South of the divide the country is very level, only occasionally relieved by gentle undulations. The streams here are very sluggish and often very crooked, some of them flowing through extensive swamps, as, for instance, the Peter Scott swamp in the town of Schroeppel, which in extent rivals the celebrated Cicero swamps in Onondaga County.

North of the divide the surface of the country is very different. Parallel ridges separated by narrow valleys constitute the distinctive features of the topography of the region. The ridges, and more especially the valleys, have their longitudinal axes at right angles to the shore of the lake and nearly parallel with the river. To the ridges local names are applied as "Paddy Ridge" where an Irish settlement occurs, "Ridge Road" and "The Hog Back," the last name being applied to at least two ridges in different parts of the county. The streams of this northern slope follow the valleys between the ridges and consequently flow into the lake rather than into the river. Black Creek, the only stream of any size that empties into the river from the east is deflected at one part of its course several miles before it finds a break between the ridges through which to flow. The ridges, technically known to geologists as drumlins, are not continuous for any considerable distance, the longest being sometimes several miles, the shorter often being less than a mile; they are, as a usual thing, terminated much more abruptly at their northern than at their southern end. Good examples of the abrupt termination is afforded at Seneca Hill where the river passes so near the hill as to cut away a portion and form a bluff. Another striking example occurs at the northern terminus of Jackson Hill, about three miles north of the village of Fulton. Their southern end usually flattens out gradually, and may be entirely lost in the confluence of several hills.

THE SWAMPS AND LAKES.

The furrowed character of the northern slope just described afforded exceptional opportunities for the formation of lakes and swamps. The underlying drift of the whole region is a blue hardpan, very impervious to water, and we may suppose that as the water in post-glacial times receded, every depression was left full of water. Many were shallow and were soon filled to the brim with vegetable mould; others were deeper and are even now barely full, while some still contain lakes which the invading plant-life is constantly making smaller. There are presented here all gradations between wooded swamps and open lakes. Some swamps, now mostly wooded, as for example, the Wine Creek swamp near Oswego, still have sphagnum persisting in them, and are, no doubt, lakes filled only at a comparatively recent date, while the vegetable accumulations are so shallow in other wooded swamps as to lead one to believe that the ponds which originally occupied them were relatively soon displaced.

Not only does the contour of the country in the northern part of the county determine the flow of the streams, but it likewise determines the form of the lakes and swamps. They are, so far as I am aware, always elongated in a northerly and southerly direction, some of them being several miles long and less than a mile wide.

TYPICAL SWAMPS.

I have selected three swamps from the score or more within the limits of the county, not because they illustrate better than others the observations to be recorded, but rather because they illustrate swamps in different stages of maturity. I have already hinted at what is meant by the maturity of a swamp. The woodėd swamps with shallow accumulations of vegetable material, sometimes called muck, matured early in the post-glacial history of the region. Some are just coming to maturity, examples of which have already been cited, and there are still others which are maturing, but will still require many years for their completion.

For want of a better term I have used the word swamp in an extended sense to indicate the whole depression, whether it be covered with water, woods or moor.

MUD LAKE.

Mud Lake is situated in the southwestern corner of the town of Oswego. It is about eight miles southwest of Oswego City, and perhaps four miles from the shore of Lake Ontario. The depression in which it lies is one of the largest in the northern part of the county, as indeed, the lake is one of the largest of the numerous small lakes in that section. It is about a mile long by somewhat less than three-fourths of a mile wide. The lake lies in a region where the fluted character is not so pronounced as it is in some other sections, nevertheless the lake itself is elongated in a northerly and southerly direction, and the whole depression of which the lake forms but a small fraction is more than twice as long as wide. This lake has withstood the encroachment of the land-making forces better than many of the lakes in the country, probably on account of its greater depth, yet, if the testimony of old residents is to be trusted, and in this respect at least I have no doubt it is, the surrounding moor is encroaching upon the lake very fast. The moor surrounding the lake is the most extensive one in that section.

THE LILY MARSH.

The swamp known by this name is better known to the people living in that vicinity than other moors as large, or even larger, and probably for two reasons. One is that for many years it has been a famous hunting ground for white rabbits in winter; the other is because a highway was constructed many years ago directly across the open part of the swamp, the open, softer portion being bridged with a long plank bridge. Few people in that part of the county but have had occasion to drive across it, an experience not soon forgotten, at least by a timid person. The Lily Marsh is situated in the southwestern corner of the town of New Haven. It presents the phenomena of a lake just disappearing. The lake in the center is reduced to a mere pool not more than twenty rods long and half as many wide. I have had very definite statements from men who could remember well when the bridge was built, and they assured me that at that time the lake reached to the bridge; now it does not reach within fifteen rods of it. Notwithstanding the fact that the lake in the Lily Marsh is almost overgrown, the swamp itself is a very extensive one. The whole depression in which it lies is very long and narrow. I did not attempt to get actual measurements of its length and width. From what I could see in it and from the highway I should judge it to be not far from four miles long, and in no place more than three-quarters of a mile wide. In this, as in the other swamps which are nearly mature, the wooded belt covers by far the greater portion of the marsh. There is left here, however, an open bog nearly, if not quite, a mile long, and from twenty to thirty rods wide.

GRANNY'S ORCHARD.

This is the last of the three depressions selected for illustration. It is a marsh in which there is no lake, nor has there been one in the memory of the persons living thereabouts. It takes its name through the resemblance the open portion of it bears to an orchard and a well-confirmed story that a man known universally in those parts as "Granny" attempted at one time to reclaim some of this land by draining it. It is in the eastern part of the town of Palermo, and lies well up toward the divide between Oneida Lake and Lake Ontario. There are more large swamps in this vicinity than in any other part of the county. To these some of the residents apply indiscriminately the term Granny's Orchard, but I feel sure the name originated in the manner I have described, and is restricted by a majority of the people to this single swamp. Yet the appropriateness of the name might easily lead to its more general use.

It is a very extensive swamp. In fact it must be confessed that we had hard work to estimate distance in this place, the view was so intercepted by trees and shrubs. The open portion of the swamp is surrounded by a densely wooded belt, and shrubs and trees of the most aggressive species have invaded the moor until it presents the appearance of an orchard, the trees of which are here represented by tamaracs and spruce. The level openings between are carpeted with sphagnum. The extent and nature of the wooded belt repels visitors even in summer, so that it is seldom visited except by adventurous huckleberry gatherers in August. The man who guided me into the bog, the first time I visited it (himself an old resident), thought it would be unsafe to venture in there in spring or autumn. To the north of Granny's Orchard proper the wooded belt stretches away for several miles. Catfish Creek, a small stream, flows through the northern end of the swamp, flowing north into Lake Ontario. The small, sluggish stream draining Granny's Orchard flows south into Oneida Lake. It is evident that the whole swamp was once a large lake, and whether it drained into Lake Ontario or Oneida Lake remains to be investigated. The gulf cut through the whole hill where Catfish Creek leaves the swamp suggests that it may have been cut through after the lake had partially filled. I have not yet had an opportunity to study the outlet to the south.

ORIGIN OF THE MOOR FLORA.

If we may judge from the actual conditions existing now in Arctic regions, immediately succeeding the glacial epoch this whole region was clothed with a vegetation resembling that now existing in our moors, indeed, resembling it much more than does any other feature of our present flora with the possible exception of the Alpine plants still persisting on our mountain tops. It is indeed an extraordinary circumstance that our lowest (in altitude) regions and our highest regions should have preserved to us a flora which is, for the most part, extinct. Since the Alpine plants and many of the bog plants draw nearer and nearer together so far as situation goes, as we go northward, until finally we find them mingled, our statement of the case is a correct one, and confirms the idea that our moor floras are remnants of an Arctic vegetation once predominating here.

THE RAPID ACCUMULATION OF MATERIAL IN THE DEPRESSIONS.

Although such a condition may not have actually existed, we may assume, for the purpose of illustration, that one of the depressions caused by the ice in this movement was left naked by the sudden lowering of the water level in the region. A lake would be left in the depression. The moisture held in the soil of the surrounding hills would steadily gravitate toward the lake and form springs. The water from these would often more than offset the loss of water from the surface of the lake by evaporation. On the shores of these lakes would be afforded a congenial place for the first plants, among which, no doubt, sphagnum was prominent. The available food supplies in the soil of the hills around was washed and afforded food for these plants. As plants grew upon the hills, vegetable humus accumulated, and the wash from this further enriched the soil at the shore. But while this washing contributed something to the accumulations of the swamp, it, under no circumstances, can be compared to the soil washed down upon the flood plains of upland streams, and for the reason that these streams are not rapid enough to carry much solid material. The accumulations in the swamps are almost entirely the decayed plants that have grown there.

ABILITY OF THE LAKE TO RESIST INVASION.

The factors which determine the ability of the lake to resist invasion are its depth and the character of its shores. If the conditions are right, a lake even of considerable depth will be steadily encroached upon by vegetation. On the other hand a shallow lake will grow over much more rapidly. There is a popular notion that a cranberry bog may grow right over a lake, and that the flexible turf is like a blanket spread over the surface of the water. Walking on these places certainly gives one that impression. I have never seen a case where this was the actual condition of affairs. If you penetrate the turf anywhere you will find the blackest and softest kind of mud, almost as mobile as water, but as a plant food much more nutritious. From a boat there sometimes appear deep recesses far under the turf, but these are more apparent than real. There are often recesses under the turf, just as there are under harder shores, but these are not deep, and I feel reasonably sure that the floating moors float upon mud rather than upon water.

THE EFFECT OF WIND UPON THE RELATIVE POSITION OF LAKE AND BOG.

The position of the lake, with reference to other parts of the swamp has attracted my attention for some time. The lakes in the northern and western parts of Oswego County have, as a general rule, their eastern shore hard, while the others are bordered by moors or by wooded swamps which are but matured portions of a moor. This is true of Mud Lake, Lake Neatahwantah, Paddy Lake, and the small lake in the Lily Marsh, all within twelve miles of Lake Ontario. At one time I thought the scarceness of springs might account for the failure of moors to form. But further observation led me to think their meagre occurrence on this shore the result, rather than the cause, of the absence.

There is what seems to me sufficient evidence to show that it is the action of the waves upon the eastern shore that prevents the formation of bogs there. At Mud Lake I have seen large masses of sphagnum and other plants from the west side of the lake lodged upon the east shore. Instead of taking root and growing they were soon washed to death by the waves. The action of the waves is very vigorous on the east shore of all the larger lakes. It is true also that where lakes are well-nigh filled up and the force of the waves is comparatively slight, the moor will begin to build from the eastern shore, but the belt constructed will be narrow compared with that on the other shores. This is the condition now existing in the Lily Marsh. Still another consideration points in the same direction. The small lakes in this particular region and the larger ones more remote from Lake Ontario have bogs on all sides of them.

Anyone who has lived in the region need not be told that prevailing winds are from the west. Their intensity, which, by the way, is often considerable, depends upon the long stretch of open lake to the west, and also, perhaps, somewhat upon the saturated condition of the atmosphere as it is swept in from the lake. The wind from Lake Ontario is so strong as to produce a decided effect upon the trees growing near the shore. They stretch their branches and often, indeed, lean toward the southeast. Another striking illustration of the power of the winds on the lake shore is seen in the great drifts of sand along the shore, sometimes called sand-dunes. Nor is the drifting of sand confined to the immediate shore of the lake. There is a sand hill in the town of Albion near a hamlet called Dugway, quite as far from the lake shore as the lakes we are discussing, where the wind drifts the sand very considerably. Another one is said to occur between Sand Bank and Centerville in the same town. A visit to the former showed that the wind was actually moving a hill east, moving it grain by grain, but nevertheless very rapidly. The highway running north from Dugway formerly passed along the east side of the hill near its base. Old residents told me that the hill was originally wooded. After being cleared away it was cultivated and finally was seeded and used as a pasture. The work of the wind began when it was used as a sheep pasture. The sand drifted into the road until the people were hardly able to haul loads over it. An attempt was made to stop the sand by building a high board fence. The sand immediately began to drift against the fence and finally drifted over it, so that now only the tops of the boards can be seen. Failing in their attempt to fence out the sand, the people have bridged it over with planks for a distance of forty rods or more. All this goes to show that the west winds in this region are unusually strong, and produce a decided effect upon other features of the region as well as upon the lakes.[1]

UNIFORMITY IN MOOR FLORA.

One of the strongest pieces of evidence to support the view that the whole face of the country was once covered with a vegetation much more like that in our moors than like that upon our highlands, is the uniformity of the moor flora. The sphagnous moors are isolated, but we find the same species of plants in them all. It is impracticable for plants to migrate from one to another at the present time. The moors remind one of an island in the open sea—islands which preserve to us a primitive flora.

So constantly are certain species present in the moors of the whole eastern United States, that upon entering a moor one begins to look for certain species, and at once misses any one that does not happen to occur in that particular moor. An example: *Kalmia glauca* does not now occur in the Cayuga Lake basin, but it occurs in many of the moors to the east and north, even appearing in the adjoining county, i.e., Cortland.

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[1] Since writing the above, Warming's *Oekologische Pflanzengeographie* has appeared, and in it, p. 365, is described the effect of the wind upon the lakes and moors of Denmark. The effect is the same as here described.

THE ZONES OF A SWAMP.

The character of the vegetation enables us to divide a complete swamp into three natural zones:

First, the *lake* in the center, which, although not a belt at all, may, for convenience sake, be so designated.

Second, the *moor* comprising the open area surrounding the lake and generally grown over with sphagnum. There are no shrubs or trees here capable of casting extensive shade.

Third, the *wooded belt* comprising the remainder of the swamp. It varies in width, and in this particular region is apt to be of considerable width north and south of the lake.

In the maturing of the swamp these disappear in regular succession from one to three. Local conditions bring about a great variation in the relative extent of the several zones. At Malloryville, Tompkins County, N. Y., is a swamp with a very narrow wooded belt, due, no doubt, to the steepness of the shores of the depression; the lake here has been completely filled up, so that we really have a moor surrounded by high ground. The wooded belt is, however, a marked feature of the swamps in Oswego County.

(*To be continued.*)

EDITOR'S TABLE.

The next issue of the American Naturalist will appear under entirely new management. The magazine has been purchased from the estate of the late Professor Edward D. Cope by a number of gentlemen who are interested in the advancement of the natural sciences, and Dr. Robert P. Bigelow, of the Massachusetts Institute of Technology, Boston, has accepted the post of Editor-in-Chief. He will be assited by an Editoral Committee and by an able board of Associate Editors, whose names will be announced later. The general scope of the journal will remain unchanged, and a high standard will be maintained in every department. It is hoped that naturalists in all parts of the country will find the AMERICAN NATURALIST a convenient medium for such of their communications as may be of general interest to others working in the same general field, as well as to specialists in their own lines. Intending contributors are invited to send manuscripts directly to Dr. R. P. Bigelow, Massachusetts Institute of Technology, Boston, Mass.

THE meeting of the Association of Agricultural Colleges and Experiment Stations at Minneapolis, in the month just past, cannot fail to be productive of good. It brings out forcibly the endeavors of Americans as a people to ameliorate the conditions of the agricultural classes, reminding us, as it does, that some $1,890,000 were appropriated by Congress for the fiscal year ending June 30, 1898, for agriculture. Of this something like $1,170,000 is for scientific investigations under the direct supervision of the Department of Agriculture, and the rest ($720,000) for maintaining the experiment stations. The departmental divisions falling within the domains covered by the American Naturalist receive various amounts as follows: Botany, $23,800; Agrostology, $18,100; Forestry, $28,520; Pomology, $14,500; Physiology and Vegetable Pathology, $26,500; Biological Survey, $27,560; Entomology, $29,500; the Bureau of Animal Industry, $755,640; and for special investigations in nutrition under the auspices of the office of Experiment Stations, $15,000.

At this meeting, among the important matters brought to light was the relation between experimental and instructional work as it exists in some of the institutions represented in the Association. The complaint was made that experimental work suffers at the expense of instructional through the overloading of the workers. Many a teacher who should have some time to carry on original work is so crowded with class work that neither energy nor time is left for anything else. The result is that those whom he is supposed to teach are forced back, more or less, into the old parrot methods of learning, lacking as they do that best of incentive to a development of their own powers, namely, the living example of an original worker constantly turning out good work.

Another matter of importance that was touched upon is the indexing of literature relating to agriculture. So far as matter emanating from the experiment stations is concerned, nothing better could be asked for than the *Experiment Station Record*. But there is needed an index that shall not be restricted to the immediately applicable—one that shall index thoroughly the entire range of the sciences, any portion of which appears at present capable of immediate use in agricultural lines. The development of the agricultural colleges should be broad and healthful and not the reverse.

Finally, there was a proposition, which was referred to the Executive Committee, to endeavor to obtain from Congress for the development of mechanical schools and courses of instruction the same encouragement that has been accorded to agriculture. The proposition is eminently a worthy one, for no class of the people, if one may judge from census returns, needs such encouragement more than this.

RECENT LITERATURE.

The Coccidæ of Ceylon.[6]—The work by Mr. E. E. Green, now to be reviewed, might seem from the title to possess very little general interest. Ceylon is a long way away; and the Coccidæ are apparently considered by most people to be unworthy of serious attention, except with a view to their destruction. Now while the economic side of Coccidology is highly important, it is maintained that the subject possesses also a strong Darwinian interest, and that the perusal of such a work as Mr. Green's will—or should—grealy profit any naturalist who interests himself in general biological problems. We have in these Coccidæ a strictly Homopterous type, but so modified that the family falls outside most of the current definitions—not only of Homoptera, but of Insecta! Combined with a remarkable reduction and even loss of parts, is the development of new characters of the most diverse kind to meet the several needs of the insects. We have here a case in which the most extraordinary modification has taken place, without masking the real affinities of the group; and everything is made so clear by Mr. Green's descriptions and beautiful colored plates, that no intelligent person could fail to understand the exact condition of affairs.

Not only should the work be examined by naturalists, but it should be shown to students of biology in our colleges. It ought to encourge all those who aspire to do original work in biological science. For very many years, naturalists have collected and observed in Ceylon; yet here comes Mr. Green, at the end of the nineteenth century, and reveals a whole series of remarkable forms whose existence had remained unknown. Until Mr. Green began to study Coccidæ, the species of this family had never been collected or studied properly in any part of the great Oriental region, and for Ceylon only seven species had been recorded. Mr. Green has found considerably over a hundred, most of them new to science, and he estimates that over two hundred will eventually be found in the island. Of the 30 forms described in the part of the work now before us, 18 were first described by Mr. Green. And there are innumerable other localities in the world, where the Coccidologist may reap a similarly abundant harvest. There is a tradition among Entomologists, that these insects are extraordinarily difficult to study. The difficulty is much more imaginary than real; the methods of preparation for study are different from those required for other insects, but they are easily learned, and the characters of the species are readily determined with the aid of a hand lens and a compound microscope. The method of procedure is fully explained by Mr. Green in his prefatory remarks. There is one thing, however, to be remembered: No one can intelligently study the Coccidæ of one country or region alone; since through human means the distribution of many of these creatures has become almost or quite world-wide, and one never knows what may turn up at any place. In the first part of Mr. Green's work, there are recognized in Ceylon various species first described from such diverse regions as Europe, America, Australia and Japan.

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[6] The Coccidæ of Ceylon, by E. Ernest Green, F. E. S, Part 1. With 33 Plates. London, Dulaw & Co., 1896.

In Chap. III, Mr. Green gives a new classification of the subfamilies of Coccidæ. He remarks himself, that it is doubtless imperfect; but it appears to the writer to be an improvement on all previous ones. It is especially to be recommended for its clearness and consistency, and while it must be admitted that on several points there still exists room for legitimate differences of opinion, the expected changes must chiefly depend on hitherto undiscovered facts. Mr. Green's new subfamilies, *Conchaspinæ* for *Conchaspis*, and *Tachardiinæ* for *Tachardia*, seem entirely justified. The writer regrets the suppression of the *Asterolecaniinæ*, which certainly form a very compact and natural group; while as to *Porphyrophorinæ*—he has never studied *Porphyrophora*, but *Margarodes* surely belongs to a subfamily distinct from *Monophlebinæ*. It is to be supposed that the *Ortheziinæ*, *Monophlebinæ* and *Margarodinæ* (or *Porphyrophinæ*) are the most primitive of the Coccidæ. The writer inclines to the view that the *Conchaspinæ* are related to the ancestors of the *Diaspinæ*.

Chap. IV, relates to the *Conchaspinæ*. On June 9, 1892, being the first anniversary of our wedding day, my wife and I, then living in Jamaica, celebrated the occasion by a trip to Hope Gardens. It was on this occasion that *Conchaspis* was discovered. The next year, Mr. Newstead reported the same genus (as *Pseudinglisia*) and apparently the same species, in an English hot-house. Now Mr. Green describes a very distinct new species (*C. socialis*) from Ceylon, and for the first time makes known the ♂; and I may add that Prof. Townsend has found in Mexico, on *Phemicria* at Vera Cruz, still another species, which I shall publish as *C. newsteadi*.

Chap. V treats of the *Diaspinæ*, with a very admirable introduction. The genera found in Ceylon are *Aspidiotus*, *Aonidia*, *Mytilaspis*, *Diaspis*, *Fiorinia* and *Chionaspis*. The absence of *Parlatoria* and *Ischnaspis* is noteworthy. In the writer's opinion, two or three new genera should be added to those listed by Mr. Green. The extraordinary *Aonidia corniger* Green, is unquestionably the type of a new genus, which may be called *Greeniella*, distinguished by the long radiating processes of the scale, and the simple pygidium of the ♀, armed, however, with long irregular terminal processes. *Aonidia bullata* Green, and *Fiorinia secreta* Green, also obviously require new generic names. *Aspidiotus ficus* is credited to "(Riley) Comstock," it should properly be credited to Ashmead, who first described it. Riley expressly disclaimed responsibility at the time. For *A. trasparens* or *lataniæ* are described and figured two different varieties of ♂, one reddish, the other pale yellow with a reddish thoracic band. The latter is the typical *transparens*. The species described as *A. cyanophylli* is apparently not Signoret's insect of that name; at all events, specimens sent to me by Mr. Green are distinct. These are on *Cycas* from Kandy, and will be published elsewhere as *A. greenii*. In *Aspidiotus secretus*, Mr. Green describes for the first time the adult ♀. Under *Diaspis amygdali*, it is noted, among other things, that the females (not the scale) on *Callicarpa lanata* are bright pink. *Diaspis fagrææ* Green, is a very interesting species, for while the ♀ is like an *Aulacaspis*, the ♂ scale has no trace of carination.

One of the interesting facts developed is that of the gall-producing propensities (if one may so speak) of *Grevia orientalis*. On this plant are found three galls, outwardly almost identical, one due to *Aspidiotus occultus*, one to *Fiorinia secreta*, and the third to a fungus! And what makes the case so extraordinary is, that these are the only true gall-producing *Diaspinæ* known!

I believe that what Mr. Green now calls *Mytilaspis gloverii* var. *pallida* is a distinct species, as he at first held. Mr. Alex. Craw has found on variegated *Podocarpus* from Japan a form which I propose to call *M. pallida* var. *maskelli*, because it was discussed by Mr. Maskell in Trans., New Zealand, Inst., XXVII, p. 46. The scale is too broad for *gloverii*, but narrower than *citricola;* it is not far from the color of *citricola*, not very pale as in typical *pallida*, though often whitish at the broader end. There seem to be but four groups of ventral glands, caudolateral four, cephalolaterals six.—T. D. A. COCKERELL.

Section Cutting and Staining.[7]—This is intended primarily for students and practitioners who need a brief introduction to the ways of the microscopist. It briefly describes the necessary apparatus, and the various processes to which tissues are subjected for histological purposes. In many respects it may be said to be fairly up to date, in others, as for instance, in the case of bichromate of silver methods in neurology, it is not. Formol is given as a histological reagent, but unfortunately it is given as *formal*, which is a synonym for *methylal*, as has been previously pointed out in these pages, and as any one may readily see by consulting German works on organic chemistry or by consulting Gould's "Students' Medical Dictionary"[8] (1896, Phila.). By reason of priority, and by reason of its expressing the probable relations of the formaldehyde to the water in the so-called 40 per cent. solution, formol is the proper word to use for this liquid. But as the term Formalin has been forced into use in the commercial world and will probably stay in spite of efforts to supplant it, one may as well submit and use the word that one must employ in buying one's reagents. It is obvious, that, if one calls for formal, one will get methylal.

Cambridge Natural History, Volume V.[9]—The high standard of this series as a reliable, popular scientific work is maintained in this volume. Mr. Sedgwick contributes a paper on Peripatus, giving its habits, manner of breeding, anatomy, development, and a summary of distribution, the latter point being illustrated by a map. Mr. Sinclair treats of Myriapods in the same comprehensive manner, and includes a brief account of fossil forms and their distribution. Mr. Sharp gives an introductory sketch of Insects embodying the latest observations as to their structure, the development of the individual, and the characteristic features of insect life, followed by a discussion of four of the nine orders of Insects, viz.; Aptera, Orthoptera, Neuroptera and a portion of the Hymenoptera. In these ordinary descriptions Mr. Sharp has incorporated a great deal of interesting information as to the habits and life-histories of various insects, fully demonstrating that fact may be as entertaining as fiction.

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[7] Section Cutting and Staining. W. S. Colman. 12 mo. 160 pp.

[8] Or any one of several other Medical Dictionaries.

[9] Cambridge Natural History Series, Vol. V. Peripatus, A. Sedgwick. Myriapods, F. G. Sinclair. Insects, D. Sharp. London and New York, 1895. Macmillan & Co. $4.00.

Aquatic Insects.[10]—This little volume is intended by the author to stimulate young naturalists in observing the habits and structures of living animals, and to try to discover the way in which the machinery of nature works. The writings of the old naturalists, Swammerdam, Réaumur, Lyonnet and De Geer are quoted to show what patient observation can accomplish. Eleven chapters are devoted to as many groups of fresh-water aquatic insects, one to the insects of the sea-shore and one to the peculiar contrivances of aquatic insects for locomotion, for feeding, for respiration, for egg-laying, and for attack and defence.

The drawings are in most cases made direct from the Insects and are a valuable feature of the book.

Bird-Craft.[11]—In gathering material for this delightful adddition to ornithological literature, its author has certainly had about her that "pocket full of patience" which she recommends to amateur students of bird-life. The chapters on the Spring Song, Building of the Nest, and Birds of Autumn and Winter show a long continued personal acquaintance with the habits of birds. The "Biographies" also contain notes from personal observation.

The illustrations, nearly all colored, add much to the attractiveness of the book.

Some Elementary Botany.[12]—Four very pretty books for Children have been compiled by M. C. Cooke and published by T. Nelson & Sons. The writer adopts the conversational style and imparts considerable information to his class concerning a few of the commoner English wild-flowers. A corn-field, a copse, a lane and a marsh afford material for the several books. Each volume is illustrated with a number of figures and one colored plate, and they are altogether attractive additions to literature for children.

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[10] The Natural History of Aquatic Insects. By L. C. Miall. London and New York, 1895. Macmillan & Co. $1.75.

[11] Bird-Craft. By Mable Osgood Wright. New York, 1895. Macmillan & Co. $3.00.

[12] Around a Corn-field. A Stroll in a Marsh. Through the Copse. Down the Lane and Back. By Uncle Matt (M. C. Cooke), London, Edinburgh and New York, 1895. T. Nelson & Sons, Pub.

The Senile Heart.[13]—In this small octavo of some three hundred pages, Dr. G. M. Balfour states the causes for the enlarged heart frequently found in adults past their prime, its symptoms, and the concomitants and sequelæ. He then suggests a general mode of treatment for this widespread cardiac trouble followed by a chapter on the prognosis of special symptoms and the treatment with special reference to these symptoms.

Marginal synopses of the points touched upon in the several paragraphs make the book a handy reference volume.

Sixth Annual Report of the Missouri Botanical Gardens.[14]—This Report includes the following scientific papers: Revision of the North American species of Sagittaria and Lophotocarpus, Jared G. Smith; *Leitneria floridana*, Wm. Trelease; Studies on the Dissemination and Leaf Reflexion of *Yucca aloifolia* and other Species, H. J. Webber; Notes on new or little known Species, J. G. Smith; Notes on the Mound Flora of Atchison Co., Missouri, B. F. Bush.

All of these papers are well illustrated with page plates of excellent drawings.

AMERICAN NATURALIST LIST OF RECENT BOOKS AND PAMPHLETS.

ADAMS, G. I.—The Extinct Felidæ of North America. Extr. Amer. Journ. Sci., Vol. I, 1896. From the author.

ADLER, F.—The Monroe Doctrine and the War Spirit in the United States. Ethical Addresses, Ser. III, No. 1, 1896. From the author.

AGASSIZ, A.—The Elevated Reef of Florida, with Notes on the Geology of Southern Florida by Leon S. Griswold. Extr. Bull. Mus. Comp. Zool. Harvard Coll., XXVIII, 1896. From the author.

BANGS, O.—On a small collection of Mammals from Lake Edward, Quebec. Extr. Proceeds. Biol. Soc. Wash., 1896.

BASCOM, F.—The Structures, Origin and Nomenclature of the Volcanic Rocks of South Mountain. Reprint Journ. Geol., Vol. I, 1893. From the author.

BAUR, G.—Der Schädel einer neuen grossen Schildkröte (Adelochelys) aus dem Zoologischen Museum in München. Aus. Anat. Anz., XII, Bd. 1896. From the author.

BAUER, K.—Ein Fall von Verdoppelung der oberen Hohlvene und ein Fall von Einmündung des Sinus coronarius in den linken Vorhof. Jena, 1896. From the author.

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[13] The Senile Heart. Its Symptoms, Sequelæ, and their Treatment. By G. W. Balfour, M. D. New York and London, 1894. Macmillan & Co. $1.50.

[14] Sixth Annual Report of the Missouri Botanical Gardes. St. Louis, 1895.

BONAPARTE, R.—Une Excursion en Corse. Paris, 1891. From the author.

BONNEY, T. G.—The Serpentine, Gneissoid and Hornblende Rocks of the Lizard District. Extr. Quart. Journ. Geol. Soc., 1896. From the author.

BOULE, M.—Les Glaciers Pliocènes et quaternaires de l'Auvergne. Extr. Comptes Rendus, 1895. From the author.

BRANNER, J. C.—Decomposition of Rocks in Brazil. Extr. Bull. Geol. Soc. Amer., Vol. 7, 1896. From the Society.

DAMES, VON W.—Ueber die Ichthyopteryier der Triasformation. Sitzungsb. k. preuss. Akad. Wissen. Berlin, 1895. From the author.

DAVIS, W. M.—Plains of Marine and Subaerial Denudation. Bull. Geol. Soc. Amer., Vol. 7, 1896. From the Society.

DAWSON, G. M.—Glacial Deposits of Southwestern Alberta in the Vicinity of the Rocky Mountains. Extr. Bull. Geol. Soc. Amer., Vol. 7, 1895. From the author.

FOWKE.—Discoidal Potsherds. Extr. Eth. Ann., Vol. 13. From the author.

GILBERT, G. K.—Presidential Address before the Geological Society of Washington, 1895. Washington, 1896. From the author.

GROTE, A. R.—Die Saturniiden. Mittheilungen aus dem Roemer. Mus. Hildesheim, Nr. 6, 1896. From the author.

HOWES, G. B.—Address delivered before the Malacological Society, 1896. Extr. Proceeds. Malacol. Soc., Vol. II, Pt. 2, 1896. From the author.

HILPRECHT, H. V.—The Babylonian Expedition of the University of Pennsylvania. Series A: Cuneiform Texts, Vol. I, Pt. II. Reprint Trans. Amer. Philos. Soc. N. S., XVIII, No. 3, 1896. From the author.

JUDD, S. D.—Descriptions of three species of Sand Fleas (Amphipods) collected at Newport, Rhode Island. Extr. Proceeds. U. S. Natl. Mus., XVIII, 1896. From the Museum.

KEYES, C. R.—Geographic Relations of the Granites and Porphyries in the eastern part of the Ozarks. Extr. Bull. Geol. Soc. Amer., Vol. 7, 1896. From the Society.

KINKELIN, DR. F.—Einige seltene Fossilien des Senckenbergischen Museum. Aus. Abhandl. Senck, naturf. Gessell., Bd. XX, Heft 1, 1896. From the author.

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General Notes.

GEOLOGY AND PALEONTOLOGY.

Hollick on Block Island.—The series of investigations carried on by Mr. Arthur Hollick in Staten Island, Long Island, Martha's Vineyard and Nantucket now includes Block Island. For several years Mr. Hollick has carefully recorded his observations, and has accumulated a vast amount of geological information, based on both paleontologic and stratigraphic data. His latest views on the relations these islands bear to each other are given in a recent paper as follows:

" Block Island has been brought into a line geologically with Long Island, Martha's Vineyard and Nantucket. They all had their origin in one series of cause and effect. They manifestly represent remnants of the former coastal plain which consisted of Cretaceous and Tertiary sands, gravels, clays and marls. The glacier of the Ice Age squeezed upward and pushed forward these incoherent strata into a series of contorted folds along its line of furthest advancement, depositing on top the detritus of the moraine. The ridge so formed was at first continuous, but with the gradual sinking of the coast, and the action of the ocean, the less elevated portions have succumbed, and only the highest parts, now represented by these islands, remain above water. All the facts point to this conclusion, and even the most superficial observation shows that the phenomena of submergence and erosion are in active operation at the present time. Should they continue in the future it requires but little prevision to appreciate that Block Island and the islands to the eastward will continue to shrink in size, disappear, and eventually form merely parts of the shoals which now connect and surround them. Montauk Point will continue to recede, and, by the submergence of the low, narrow strip of land in the vicinity of Canoe Place, a new island will be formed from what remains of the Point." (Trans. N. Y. Acad. Sci., XVI, 1896.)

Age of the Himalaya.—In a discussion of the geology of Hazara, India, Mr. C. S. Middlemiss again urges the great age of the Himalaya as opposed to the more popular idea that they were the product of yesterday, geologically speaking. He states that " it has been gradually becoming evident to all who really examine the question in detail that the Himalaya are and have been in a constant state of change; a state of elevation along the main axis and depression along the mountain-foot, with intermediate zones of crushing, crimpling, and over-riding along shear and thrust planes. Hence, in speaking of the Himalaya of a past geological age or epoch I mean that old representative of them which held about the same position, and acted functionally in the same way as does the mountain range going by the name of Himalaya to-day. It may sometimes have been represented by long parallel coast lines, or by archipelagoes with chains of mountainous islands following similar parallel lines, but that it kept certain original features, and that a core recognizable in its unity persisted throughout Tertiary, Secondary, and possibly into Paleozoic times, I have no doubt." (Mem. Geol. Surv. India, XXVI, 1896.)

Geological History of the Bermudas.—Mr. Tarr's field work in the Bermudas results in the following conclusions in regard to the history of these islands as revealed by the rocks. First, there was a base rock, formed by the waves which ground up shell fragments upon the beach. This was consolidated into a dense limestone, which was elevated and denuded, and finally depressed and attacked by the waves. During the last stage it was partly covered by a beach deposit. Then came an uplift during which a wind-drift structure of consolidated coral sand was formed on the beach rock. The last stage has been a depression that carried the level down nearly to that of the beach which was formed before the uplift occurred. This work of construction has been done in recent times, the history dating back into Pleistocene time only, or possibly early Cenozoic. (Amer. Geol., Vol. XIX, 1897.)

Canadian Paleozoic Fossils.—A systematic list of all the species from the Galena-Trenton and Black River formations of the vicinity of Lake Winnipeg, now in the Museum of the Canadian Survey, prepared by Dr. Whiteaves, is published by the Survey, with descriptions and illustrations of 26 new species. According to the author, the most striking feature of the fossils of the Winnipeg and Red River formations is the large size to which many of the specimens attain. Reference is made to one of the Receptaculitidæ (*R. owenii*) which is known to be 12–20 inches in diameter. Orthoceratites have been found measuring 4½ to 6 feet in length. Rough casts of the interior of spirally coiled discoidal shells, apparently allied to Barrandeoceras are nearly or quite two feet across. A siphuncle of *Endoceras crassisiphonatum*, which is also imperfect at both ends, is nearly 3 feet long, and the fin cheek of a trilobate, *Asaphus* (*Isotelus*) *gigas*, indicates a specimen that must have been twenty inches in length when alive.

A brief resumé of the exploration of the Lake Winnipeg limestones prefaces the descriptions of the fossils. (Paleozoic Fossils, Vol. III, Pt, III Ottawa, 1897.)

Kellaways Fauna in Baluchistan.—A monograph prepared by Dr. Noetling, and the Geological Survey of India, deals with the fauna of Kellaways from Mazár Drik, Baluchistan. The specimens which have unfortunately suffered more or less from deformation by pressure, have been carefully compared with the type specimens from the Jurassic beds of Kutch, which were worked out by Professor Waagen, and the following determinations have been made:

There are in all 22 species, of which 17 are determined specifically, while of 5 only the genus could be determined. Of the 17 forms identified 16 have already been described, while one form, *Perisphinctes baluchistanensis* is recognized as new.

The 22 species represent the following classes: Brachiopoda 2, Pelecypoda 3, Gastropoda 1, Cephalopoda 16. The character and distribution of these fossils indicates that the *Polyphemus* limestone in which they were found is the representative of the *Macrocephalus* beds of Kutch, and is homotoxial with the lower Kellaways beds of Europe.

Six page plates of lithographed drawings illustrate the work.

Fauna of the Wombeyan Caves, N. S. W.—At a recent meeting of the Natural History of Glasgow, Dr. Brown exhibited the following series of fossils from the bone breccia deposit which he had discovered recently in the neighborhood of the Wombeyan Caves in New South Wales:

1. Two almost perfect jaws of *Burramys parvus* Broom, a Diprotodont marsupial, chiefly characterized by its large grooved premolars. It is regarded by Dr. Broom as being intermediate between the Phalangers and the Macropodids. There is reason to believe that Burramys is the nearest known relative to the extinct pouched lion *Thylocoleo carnifex* Owen.

2. Two lower jaws and a specimen exhibiting the almost complete maxillary teeth of *Paleopelaurus elegans* Broom, a small Diprotodont believed to be intermediate between Petaurus and Gymnobelidens, and probably the ancestor of both.

3. Premolars and molars of *Pseudochirus antiquus* Broom, an extinct Ring-tailed Phalanger.

4. Lower jaw of *Dromecia nana* (Desm.), the small Tasmanian Dormouse-Phalanger.

5. Lower and upper jaws of *Phascologale flavipes* Waterh, the existing yellow-footed pouched mouse.

6. Lower jaw of *Phasacologale penicillata* (Shaw), the existing Brush-tailed Pouched Mouse. (Proceeds. Nat. Hist. Soc., Glasgow, Vol. IV, Pt. III (1895–96), (1897.)

A Region of Environmental Change.—One of the most important geological changes which has taken place along the Atlantic coast in recent times was the closing up of the Currituck Inlet, North Carolina, by drifting sands in 1828. Previous to that year this inlet formed such a passage from the ocean through a narrow outer beach into the waters of Currituck Sound as is formed by either the new or Ocracock Inlet to Pamlico Sound now. With the closing of the Currituck Inlet there was the conversion of upwards of one hundred square miles of shallow salt and brackish water to fresh water; and it is within the memory of men now living that the resultant changes were immediate and striking.

Previously the sound had been a valuable oyster bed. Within a few years the oysters had all died out and their shells may now be seen in long rows where they have been thrown out in dredging for a boat way in the Coinjock Bay, a southwestern extension of the Sound. Further there were such changes in vegetation as brought countless thousands of ducks of species that had been only occasional before. The salt water fishes were driven out and fresh water fishes took their place. (Amer. Journ. Sci., IV, 1897, p. 76).

Geological News.—GENERAL.—Mr. J. C. Branner questions the somewhat prevalent idea that rock decay is, like organic decay, a process of bacterial growth. He cites a number of authorities who are all agreed as to certain conditions favorable for the growth of bacteria, and quotes experiments to show that these conditions do not exist below certain limited depths of the soil. Since granites are often decomposed to depths of more than 100 feet, it is not probable that bacteria are responsible for this deep decay, or for any considerable part of it. (Amer. Journ. Sci., Vol. III, 1897.)

CENOZOIC.—The jaws of a true monkey have been found by Mr. Forsyth Major in the Æpyornis beds of Madagascar. From their size M. Gaudy infers that the animal was about as large as a man. The molar teeth recall Mesopithecus and Semnopithecus. In general appearance the teeth resemble those of the Old World monkeys, but their number corresponds with those of the New World. For this new fossil Mr. Forsyth Major proposes the name *Nesopithecus robertii.* (Revue Scient. (4) VI, 1896.)

Dr. J. C. Merriam notes the occurrence of marine Tertiary horizons at two localities in Vancouver Island—Carmanah Point and at the Sooke District. Thirty-three invertebrate species are identified from the first named place, and serve to correlate the formation with Conrad's Astoria Miocene. The fauna of the Sooke beds is quite different from any of the Oregon or Californian Miocene or Pliocene faunas known to the writer. His conclusion, however, from evidence in hand, is that the Sooke beds are of middle Neocene age, and that the time of their deposition was considerably later than that of the Carmanah Point beds. (Univ. Calif. Bull., Dept. Geol., Vol. 2, 1896.)

A recent Bulletin of the *Soc. Belge de Geol.* contains a figure of the femur of the anthropomorphous monkey found by Kaup in the Pliocene beds (Rhenan) at Eppelsheim (Haut-Rhin). At first it was decided not to separate this form generically from the Dryopithecus of Saint-Gauden's, but a recent critical comparison made by Pholig demonstrates that such a distinction should be made. He therefore proposes the name *Paidopithex rhenanus* for the Eppelsheim species. A comparison of the Rhenan femur with those of modern allied forms shows it to be more anthropomorphous, both in general and in many details, than are those of the Gorilla or the Chimpanzee. (Bull. Soc. Belge de Geol., 7, IX (1895), 1897.)

BOTANY.[1]

The Death of Sachs.—The death of Dr. Julius von Sachs, in Würzburg, on May 28th, is announced. He was born in Breslau in 1832, and was therefore sixty-five years of age at the time of his death. He was educated in the University of Prague, and in 1859 became assistant in physiological botany in the Royal Experiment Station at Tharandt, Saxony. In 1861 he became professor of botany in Bonn; in 1867 in Freiburg, and in 1868 in Würzburg. His most noted works are *Handbuch der Experimental-Physiologie der Pflanzen* (1865); *Lehrbuch der Botanik* (1st edition, 1868; 2d, 1870; 3d, 1873; 4th, 1874). *Geschichte der Botanik* (1875), *Vorlesungen über Pflanzen-Physiologie* (1882), and *Abhundlungen über Pflanzen-Physiologie* (1892). Of these the third and fourth editions of the *Lehrbuch*, *Geschichte* and *Vorlesungen über Pflanzen-Physiologie* were translated into English, and have been for years familiar to all classes of botanists in this country. The appearance of Bennett and Dyer's translation to the third edition of the *Lehrbuch* in 1875 marked an epoch in botany in America. The

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[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

German edition had been read just enough to prepare botanists for the English volume, which was received with the greatest favor. It at once became the great reference book in many a college department of botany, and this place it has maintained in many cases to the present time, although it is now nearly a quarter of a century since the author wrote the German edition. In 1882, Dr. Vines brought out an English version of the fourth edition, with additions and explanations of his own, thus bringing the work forward practically to the date of its issue. This, like its predecessor, has been extensively used as a work of reference. In 1887, Marshall Ward brought out the "Lectures on the Physiology of Plants," and in 1890, Garnsey and Balfour the "History of Botany."

The unusual clearness with which he was able to express his ideas contributed greatly to the popularity of Sachs's writings, and this, added to his power of discriminating between the less and the more important factors in the problems which presented themselves, made him one of the most helpful of modern botanists.—CHARLES E. BESSEY.

Opportunities for Research in the Missouri Botanical Garden.—A recent circular by the director calls attention to the Garden as affording opportunities for certain lines of research in botany. He says, "For this purpose additions are being made constantly to the number of species cultivated in the grounds and plant houses, and to the library and herbarium, and, as rapidly as it can be utilized, it is proposed to secure apparatus for work in vegetable physiology, etc., the policy being to secure a good general equipment in all lines of pure and applied botany, and to make this equipment as complete as posible for any special subject on which original work is undertaken by competent students.

"A very large number of species, both native and exotic, and of horticulturists' varieties, are cultivated in the Garden and Arboretum and the adjoining park, and the native flora easily accessible from St. Louis is large and varied. The herbarium, which includes over 250,000 specimens, is fairly representative of the vegetable life of Europe and the United States, and also contains a great many specimens from less accessible regions. It is especially rich in material illustrative of Cuscuta, Quercus, Coniferae, Vitis, Juncus, Agave, Yucca, Sagittaria, Epilobium, Rumex, Rhamnaceae, and other groups monographed by the late Dr. Engelmann or by attachés of the Garden. The library, containing about 12,000 volumes and 13,000 pamphlets, includes most of the standard periodicals and proceedings of learned bodies, a good collection of morphological and physiological works, nearly 500 carefully selected botanical volumes published before the period of Linnæus, an unusually large number of monographs of groups of cryptogams and flowering plants, and the entire manuscript notes and sketches representing the painstaking work of Engelmann. A complete author's catalogue of the library, shelf-marked to indicate the principal subject contents of the several works, is now in process of preparation, and will shortly be published.

"These facilities are freely placed at the disposal of professors of botany and other persons competent to carry on research work of value in botany or horticulture, subject only to such simple restrictions as are necessary to protect the property of the Garden from injury or loss."

It has been the hope of the editor of this department of the NATURALIST that the Missouri Botanical Garden should become a great inland laboratory for research in systematic, morphological and physiological botany, to which duly accredited students might be sent from the universities of the Mississippi Valley. There are many problems for whose solution botanists need tropical and sub-tropical laboratories, but there are many more for which just such facilities as are being provided by Dr. Trelease are far more useful; while the much milder climate of St. Louis, to say nothing of the difference in travelling and living expenses, still more fully justify the effort to establish this research laboratory. The returns for a certain outlay will be much greater than in some distant laboratory, and it will be far more profitable for universities to endow tables here than in less accessible places.

—CHARLES E. BESSEY.

Botanical Notelets.—Mr. C. G. Lloyd has issued his Second Report on the Lloyd Mycological Museum (Cincinnati, Ohio), from which we learn that on the first day of January, 1897, it contained 1431 specimens, representing 760 species. From it we learn also that the botanical library of the Museum contains 4387 bound volumes and about 2000 pamphlets. In this connection we may mention again the series of beautiful photogravures of American Fungi issued by Mr. Lloyd, in which the species are represented with wonderful fidelity.

Dr. C. Hart Merriam has recently described (Proc. Biol. Socy., Washington, **10**: 115) a new species of fir tree from the San Francisco and Kendrick Mts. of Arizona. It has hitherto been confused with *Abies lasiocarpa* (Hook.) Nutt., (*Abies subalpina* Engelm.) from which it differs in its corky bark, longer leaves, smaller cones and broader scales. He names it *A. arizonica.*

Mr. T. C. Palmer describes (Proc. Acad. Nat. Sci., Philadelphia, March, 1897), a method of demonstrating the absorption of carbon dioxide, and the generation of oxygen, by diatoms, by the use of inverted test-tubes filled with water tinged with hæmatoxylin. On the addition of carbon dioxide the rosy tint turns yellow, and, as the diatoms absorb the acid, the rosy tint reappears.

The third of the "Teachers' Leaflets on Nature Study," issued by Professor Bailey, is entitled "Four Apple Twigs." Like its predecessors, it is certain to be very helpful to both teachers and students.

Professor M. A. Brannon's paper on the "Structure and Development of *Grinnellia americana*," in the March number of the *Annals of Botany*, brings out a number of interesting facts about this beautiful American red seaweed. He found this species to be particularly well adapted to the study of the various phenomena of reproduction. The plant, when cut into small pieces, reproduces vegetatively by proliferation. Carpospores and tetraspores germinate readily under favorable conditions which are easily controlled. The antherozoids (which are non-motile) are formed by abstriction. The trichogynes are often branched, sometimes as many as five growing from a cystocarp. The pericarp is only two or three layers thick.

Mr. F. V. Coville publishes some interesting notes on the plants used by the Klamath Indians of Oregon (Contrib. U. S. Natl. Herb., V, No. 2) as one of the results of a botanical survey of the plains of southeastern Oregon in 1896. The plants considered range from lichens (*Alectoria fremontii* and *Evernia vulpina*) to grasses, lilies, knotweeds, roseworts, umbelworts, and composites. These plants are used for food, dyes, clothing, bows, arrows, baskets, buckets, medicines, etc.

Bulletin 9 of the Minnesota Botanical Studies maintains the high standard of this unique state publication. It contains papers on the Lichens of Minneapolis (*Fink*), the North American Hyphomyceteæ (*Pound* and *Clements*), Mosses at High Altitudes (*Holzinger*), Dorsiventral Leaves (*Day*), the Genus Coscinodon in Minnesota (*Holzinger*), the Ferns and Flowering Plants of the Hawaiian Islands (*Heller*), Symbiosis (*Schneider*), the Distribution of Woody Plants at Lake of the Woods (*MacMillan*), the Alkaloids of Veratrum (*Frankforter*).

H. J. Webber's paper on the Water Hyacinth (*Piaropus crassipes* (Mart.) Britton) in Bulletin 18, of the Division of Botany of the U. S. Department of Agriculture, describes the rapid spread in Florida rivers of a very pretty plant hitherto used for ornamental purposes, until it has now become an intolerable nuisance. It often seriously impedes, and, in fact, sometimes actually stops the progress of steamboats. The problem of its eradication is a very difficult one.

The Asa Gray Bulletin for June appears in an enlarged and improved form. The editors say in regard to it: "For some time it has been felt that there is room in the United States for a botanical magazine of a more popular nature than any which now occupy the field," and they hope to make the little magazine fill this place. G. H. Hicks of Kensington, Md., the Editor-in-Chief, is to be aided by a number of well known botonists. It should be widely circulated in the public schools.

M. C. Fernald's "Second Supplement to the Catalogue of Maine Plants" appears in the *Proceedings of the Portland Society of Natural History* (Vol. II, Part 4). It contains 101 species and varieties, several of which are described as new to science. Among the interesting additions are *Prunus cuneata* Raf., *Lythrum alatum* Pursh, *Coreopsis tinctoria* Nutt., *Fraxinus viridis* Michx. f., *Solanum rostratum* Dunal, and *Sassafras officinalis* Nees.

A new book on fossil plants is now appearing in parts from the publishing house of Ferd. Dummlers, Berlin. It is the work of Dr. H. Potonié, and bears the title of *Lehrbuch der Pflanzenpaleontologie.* The first *lieferung* contains 112 pages, and includes chapters on "fossil plants in general," "doubtful fossil plants," and a "systematic discussion of fossil remains." It is freely illustrated.

Professor F. Lamson-Scribner, the agrostologist of the Department of Agriculture, in Washington, D. C., has made a valuable contribution to our knowledge of the grasses of the United States by bringing out an illustrated bulletin (No. 7) under the title of "American Grasses," consisting of excellent figures of three hundred and two species. Accompanying each is a brief description. It is to be hoped that larger editions of these useful publications may be made in the future, so that they may receive wider distribution.—Charles E. Bessey.

VEGETABLE PHYSIOLOGY.

Chemotropism of Fungi.—Manabu Miyoshi, a student of Pfeffer in Leipsic, has considerably extended our knowledge of the behavior of fungi toward particular substances, and has opened up a wide field for speculation and experiment relative to the causes of parasitism. He experimented at first with six common fungi, all usually designated as Saprophytes, viz.: *Mucor mucedo, M. stolonifer, Phycomyces nitens, Penicillium glaucum, Aspergillus niger* and *Sapro-*

legnia ferax. Subsequently he also experimented with *Botrytis bassiana, B. tenella, Uredo linearis* and with the pollen of *Digitalis purpurea* and of some other Dicotyledons, the results being much the same except that they are attracted by fewer substances. In brief, he finds the germ tubes of the species experimented on to be indifferent to some substances, to be repulsed by others, and to be strongly attracted by still others. In some cases the attraction is so strong that an indifferent fungus-like Penicillium is converted into an active parasite by simply injecting the living leaves on which the spores are sown with a dilute solution of the attractive substance, e. g., 2 per cent. cane sugar. The germ tubes bore through the epidermis or enter at the stomata and ramify through the interior of the leaf, boring through cells as well as passing between them, while they show no tendency to enter leaves injected simply with water. The suggestiveness of this sort of an experiment is certainly very great. The spores were separated from the chemotropic substance by films of mica or collodium perforated with fine needle punctures, or by means of the epidermis of various plants. Without entering into details, some of the main conclusions reached by Mr. Miyoshi may be summed up in the following diagrams which I have prepared from his tables. These experiments were made with layers of gelatin separated by thin films of collodium containing fine needle punctures. The interrupted horizontal lines represent collodium membranes separating layers of 5 per cent. gelatin, previously washed in HCl to remove the disturbing, nutrient lime salts. The dotted areas indicate the particular layer of gelatin containing the spores to be tested. The diagonally shaded areas indicate the layers of gelatin to which the chemotropic substance was added, in these cases 2 per cent. cane sugar. The vertical lines represent the walls of the glass dishes. The arrows indicate the direction of the movement of the germ tubes when there was marked chemotropism. Zero denotes that there was no movement of the germ tubes into the compartment, and * indicates that the germ tubes grew indifferently in all directions. In the first diagram the experiments were with *Phycomyces nitens* and *Mucor stolonifer*, in the second with *M. stolonifer*.

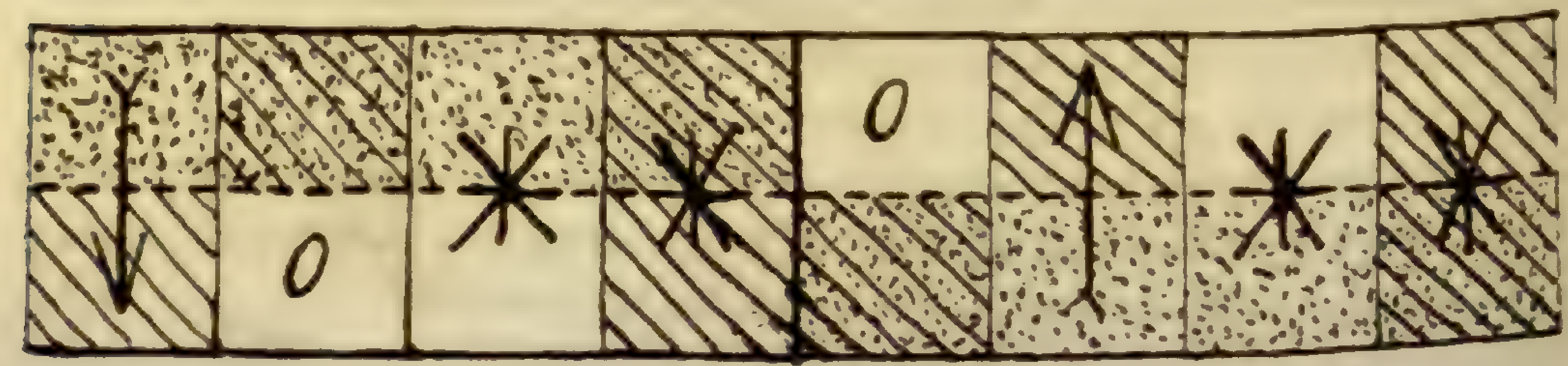

Fig. 1.

Mr. Miyoshi finds that within certain limits it is the difference in the concentration of the chemotropic substance in two layers rather than the amount of concentration which controls movement. Positive chemotropism gradually disappears as diffusion renders the concentration slight. The concentration difference must be 1 : 10 or more to induce decided turning. If the concentration is great, negative chemotropism is apt to set in, e. g., *Mucor mucedo* shows strong, positive chemotropism to 2 per cent. cane sugar solution, it is feebly positive with 0.1 per cent., while with diluter solutions the fungus does not react; with solutions stronger than 2 per cent. the positive reaction increases up to 10 per cent., and then slowly decreases at 15, 20 and 30 per cent., becoming negative at 50 per cent. We reproduce one of Mr. Miyoshi's figures showing the movement of the germ tubes of *Saprolegnia ferax* into a puncture in a collodium plate through which 2 per cent. meat extract was diffusing. Hyphae inside the circle of diffusion always turned their growing point toward the zone of higher concentration and finally entered the opening where it was strongest. Identical results were obtained in light and dark rooms. The experiments seem to have excluded heliotropism, geotropism and all movements due to simple contact.

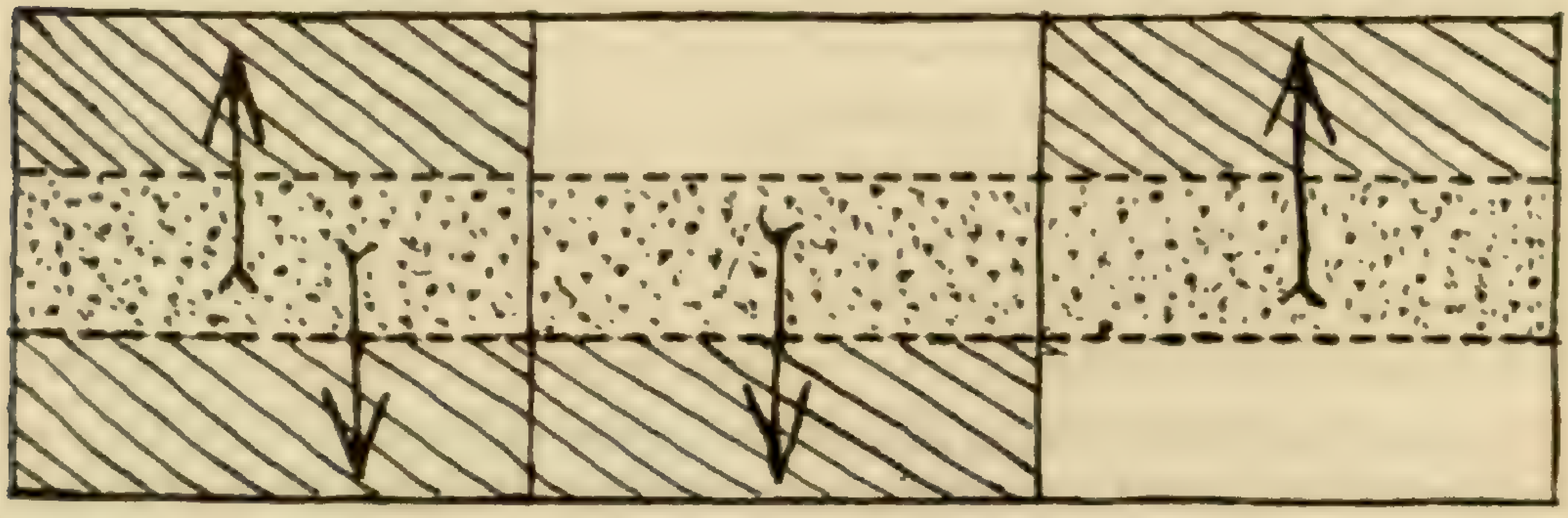

Fig. 2.

Pfeffer's capillary tubes in water or very dilute nutrient solutions under cover glasses were also used, but this method, while giving some interesting results, is stated to be better adapted to motile organisms. Many substances were found to attract, and a long list is given with the behavior of the six fungi first mentioned toward different concentrations. Among the strongly attractive substances were ammonia compounds, phosphates, meat extract, peptone, sugar, dextrin, asparagin, etc. The

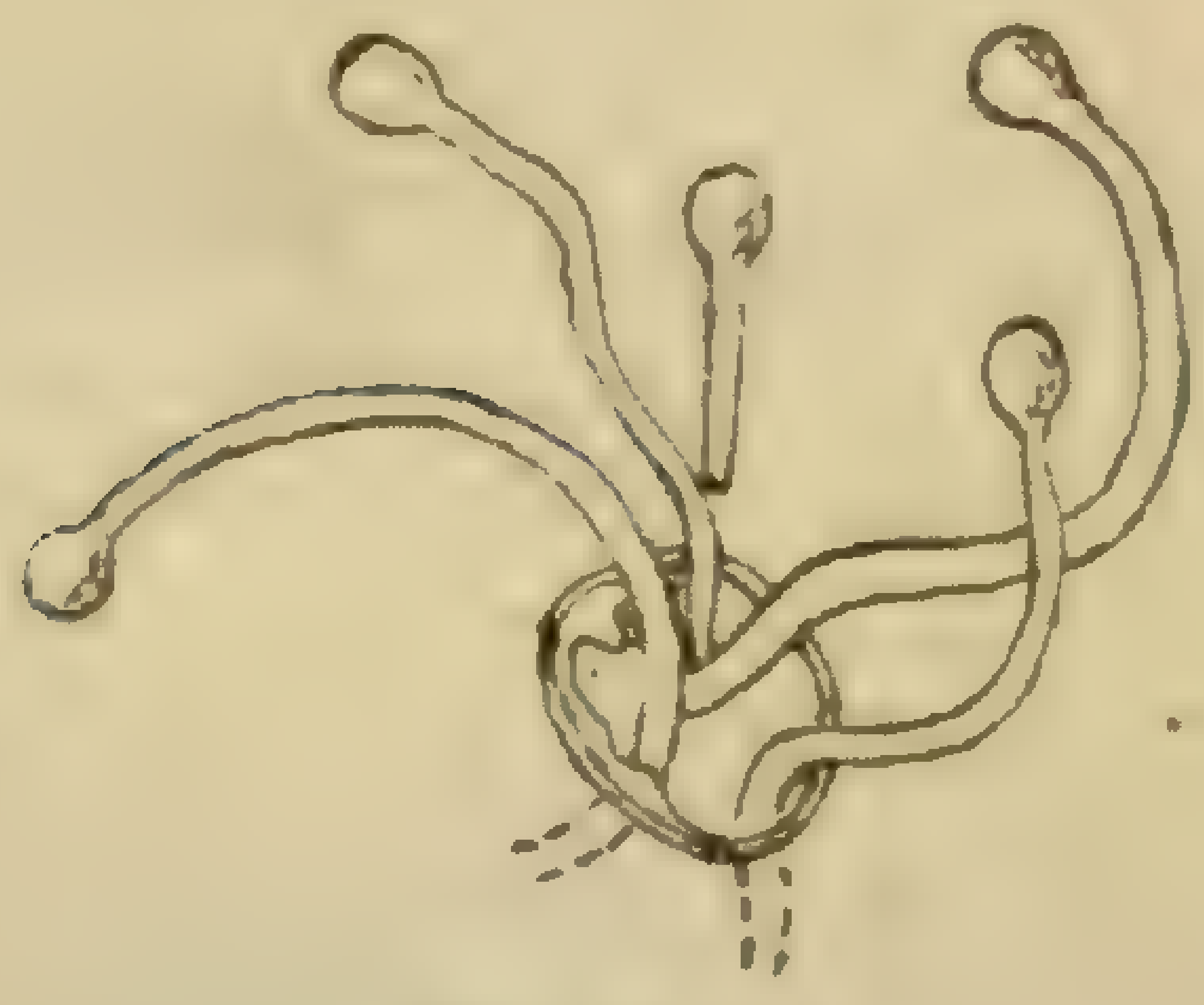

Fig. 3.

following compounds caused repulsion: organic and inorganic acids, alkalies, alcohol, calcium nitrate, magnesium sulfate, sodium chloride, potassium nitrate, chlorate and chloride. The nutrient value of a substance, it is said, in no way corresponds to its chemotropic stimulus. Glycerin is cited as example of a good food which has scarcely any chemotropic action. The five molds were specially attracted by sugar, while the Botrytis showed a special preference for meat extract and peptone and no liking for grape or cane sugar. The pollen tubes were indifferent to meat extract, peptone and asparagin, but were attracted by grape sugar, cane sugar, dextrin and plum decoction. The title of this paper is *Ueber Chemotropismus der Pilze.* It occupies all of *Botanische Zeitung.* 52 Jahrg. 1 Abt. Heft I., and is well worth reading by all who are interested in the cultivation of fungi.

—Erwin F. Smith.

ZOOLOGY.

Origin of Life.—The following interesting speculation as to the origin of the organic forms of the earth is advanced by Mr. Charles Morris. There was a time in the earth's history, when chemical inaction prevailed, on account of high temperature and unfavorable physical conditions, but, on the formation of an ocean of highly heated waters, holding in solution a variety of elementary substances and simple compounds, chemism grew active, and became more energetic as the waters increased in depth and in variety and volume of their contents. Many complex minerals were very likely then formed and deposited as rock formations. As the ocean became freed from its abundance of foreign material inorganic chemistry decreased, until now it has practically ceased, oxidation having reduced nearly all substances to a state of chemical fixity.

As the waters of the primeval ocean slowly cooled, and inorganic chemism declined in activity, organic chemism probably set in, aided by the solar rays. The material for this new phase of action had been prepared and existed abundantly in the water and air. It may have had its origin in an early reaction between carbon dioxide and the elements of water, yielding the hydro-carbons; and subsequently between these and nitrogen, yielding the far more complex albuminous compounds.

Many of the preceding mineral molecules were quite complex in composition, and it is reasonable to suppose that still more complex molecules arose under conditions restraining the activity of oxygen. Seed forms of organic substance may have first appeared—simple carbon compounds. These would serve as the basis of more complex molecules, and there may have been a long-continued process of deoxidation and formation of higher carbon and nitrogen compounds until true organic matter appeared and the chemistry of life came fairly into play.

Further the author remarks that "the conditions favoring the development of organic material were transitory, and no longer exist. Organic chemistry emerged from a vitally active stage of inorganic chemistry. It could not well arise from the existing passive stage of inorganic chemistry." (Proceeds. Acad. Nat. Sci., Phila., 1897).

The Life Cycle of the Coccidii of Arthropods.[1]—During the course of his researches on the Sporozoa of Arthropods Liger came to the conclusion that the form that has been described under the name of Eimeria is not an independent animal but only a form in the life cycle of Coccidium. In the intestine of myriopods and of insects, embracing species of Himantarium, Stigmatogaster, Lithobius, Cryptops, and Tipula, two forms of the parasites were always present. In the myriopods there could be recognized, (1) cysts of Eimeria, growing and mature, enclosing numerous sporozoids regularly disposed and enveloped in a delicate wall; (2) free active sporozoids, that might be seen in the process of becoming detached from those just noted; (3) intracellular forms, among which one might recognize all the transitional forms between the sporozoids just noted and the encapsuled form marking the end of the period of growth; (4) encapsuled forms, free or still intra-cellular and showing the beginning of the division of their contents into four granular masses; (5) these same cysts in a mature condition with four oval spores each containing two sporozoids.

An examination of the excrement of a Himantarium that was later found infested showed the existence there of the cysts of Coccidium, which are to be considered as giving rise to Eimeria. The sporozoids of Eimeria were found incapable of existing in water. As further supporting his position he cites the fact that when Coccidium is present, so is Eimeria, and when one is absent, so is the other. This coëxistence of the two forms in the same animal has been long known, and it is added that an arthropod has never been found containing a Coccidium with lasting spores that did not also harbor an Eimerian form.

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[1] L. Liger. C. R. Acd. Sci., CXXIV, pp. 966.

Summarizing his facts he states that the cycle of the Coccidium is as follows:

"Eimerian sporozoid, encapsuled form, tetra-spored cyst (Coccidium), Coccidian sporozoid (that enters the host), eimerian bud-group, and then the Eimerian sporozoid.

In a promised paper the author expects to show the relation between a coccidium and a gregarine, but not by an identification with a morocystial as Mingazine has attempted to do nor by a doubling of the cycle as Schneider did, but by considering the Eimerian sporozoid as equivalent to the gregarine sporo-blast and the lasting tetra-spored cyst of a Coccidium as the analogue of the gregarine spore.

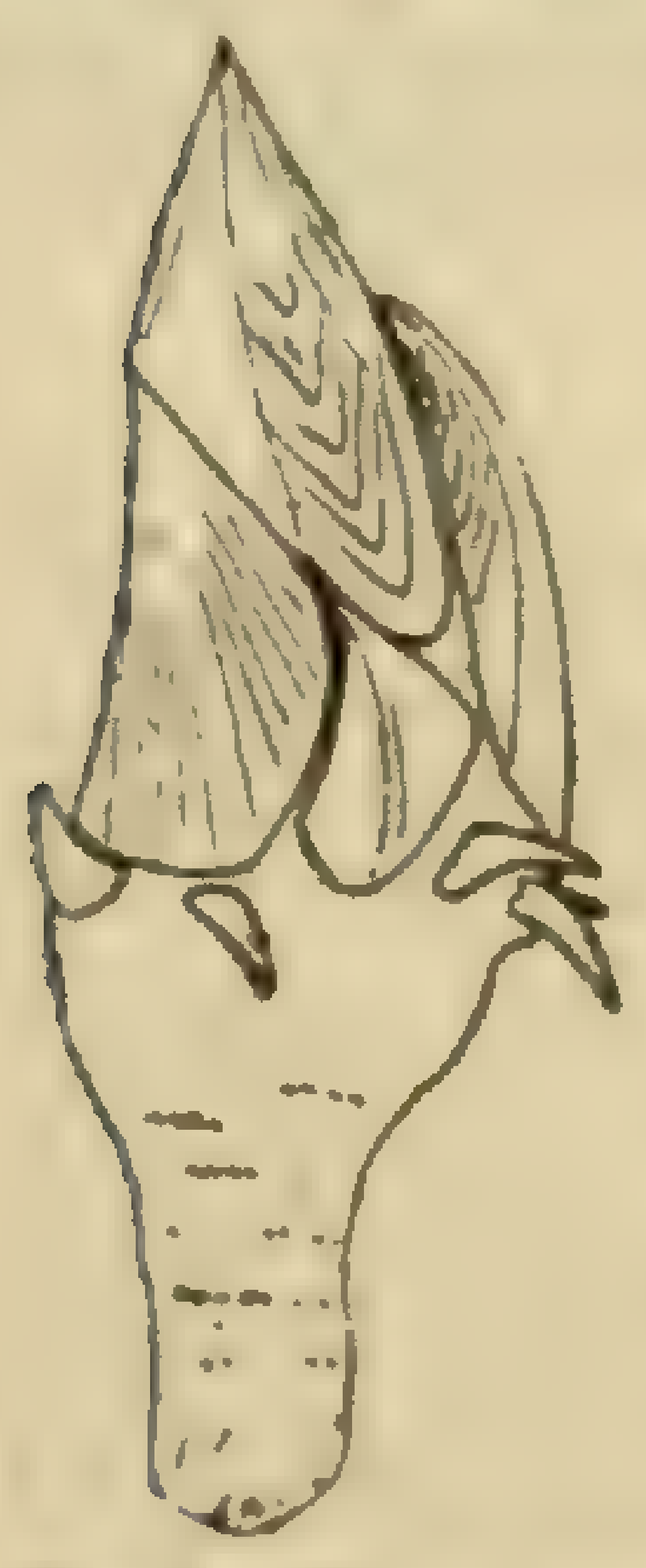
The Nephridia of the Nemertine, Stichostemma eilhardi Montg.—A brief paper on this subject by Dr. Montgomery contains some very striking facts, which have a somewhat important bearing upon the weight to be given nephridia in constructing phylogenetic trees. As a case in variation the worm described simply adds another example to those that have been accumulated showing that the forms of animals, of plants, the number of various portions of their anatomy, etc. are much less fixed and regular than has been previously supposed.

This particular worm we are informed differs from all other known nemerteans (1) in having several consecutive nephridia on each side of the body instead of a single pair as is the case in others forms; (2) in the fact that not all of the nephridia are provided with excretory ducts; (3) in the nephridia extending from one end of the body to the other; (4) in the great number of excretory ducts; (5) in the cavity of the terminal bulbs being closed and hence not in open communication with the lumen of the ductules; (6) in the presence of a closed cuticular structure surrounding the cavity of the bulb which may be produced by the cells of the latter; (7) in the probable absence of a ciliary flame in the bulb; (8) in the comparative great length of the ductule connecting the bulb with the main duct; and (9) in the possession by the epithelium of the main ducts of a cuticula of considerable thickness.

No evidence of a connection between the nephridia and the blood vessels was found.

The peculiar features of the animal the author seeks to explain as due to the adaptation of the ancestors of the worm from a marine to a fresh water life. There is a question, however, as to whether such a cause is properly assumed for the peculiarity of consecutive nephridia instead of the single pair found in all other nemertines, and for the irregularities to be noted in the supply of excretory ducts. As shown by the author's diagram the nephridia look fragmentary; there is no regularity in their length, nor do the numbers of the fragments show evidence of bilateral symmetry. But the author himself suggests that the specimen may be a monstrosity, and that a study of other specimens might show both bilateral symmetry and more regularity in the arrangement on each side. Such a further study is certainly needed. Until it is made one might very reasonably suppose that it is possible that the nemertine nephridia and their ducts are not stable in their arrangement. And this supposition would be supported by the fact that in Pauropus,—an animal much higher in the scale of life than the nemertine worm in question and therefore, according to general opinion, probably less likely to vary,—one finds the seminal ducts (metamorphosed nephridia) coiled upon themselves and anastomased in a most peculiar, manner with no evidence of bilateral symmetry and showing no evidence of constancy of arrangement or in the position of the three small ducts leading from the testes in different individuals. Further one frequently finds that portions of the large ducts have become cut off from the remainder and left without communication with the exterior, very much as is shown to be the case with the ductless nephridia in Dr. Montgomery's figure.

Description of a Remarkable Japanese Cirripede.—SCALPELLUM SEXCORNUTUM n. sp. General form of capitulum triangular, the ventral side nearly straight, dorsal convex; upper whorl of plates perfectly and normally calcified, lower whorl with small, peculiar plates. Valves 13. Surface everywhere densely and minutely pilose. *Carina* simply bow-shaped, weakly arched, the apex or umbo terminal above, roof strongly convex, with "eaves" or projecting carinæ at the sides, below which the side walls have some radial striæ. *Tergum* long, triangular, the carinal margin long. All margins rather straight, surface with some radial striation and a wide, but not well defined median rib, the apex erect, pointed. *Scutum* convex, subtriangular, decidedly less in area than the tergum, the occludent margin slightly concave, tergal margin straight, lateral and basal margins convex, surface radially striated. *Upper latus* somewhat triangular, the umbo above, at the apex; scutal margin long, concave, carino-basal margin convex. *Rostrum* triangular, as wide as long, the beak upturned and somewhat projecting. *Rostral latus, carinal latus* and *subcarina* developed as curved, projecting spikes or horns, small at their bases. No infra-median latus or subrostral plate. "Thorax"



Scalpellum sexcornutum Pils.

largely unprotected, collapsed in the dry specimens described. Peduncle rather short, not large, with small, sparse and separated conic scales.

Height of capitulum 18, breadth at base 11 mm.

The specimens described were collected by Mr. Frederick Stearns, and one of the cotypes is in his noble collection of Japanese invertebrates in Detroit, Mich., the other being in the museum of the Academy of Natural Sciences of Philadelphia.

The capitulum is covered with a soft dense pile, like *S. villosum* and *S. trispinosum;* but these are Pollicipeo-like species, very unlike *sexcornutum.* From all other species of similar contour, the peculiar development of the whole lower whorl of plates as projecting horns, will readily distinguish this species, which is apparently nearer *S. squamuliferum* Weltner (S.-B. Ges. Naturforsch. Fr. Berlin, 1894, p. 80) than any other described form. None of the forms described but not yet figured by Aurivillius ('Ofversigt Kongl. Vet. Akad. Förh. 1892) seem at all similar.

It may be mentioned in this connection that the Japanese species described by me in 1890 as *Scalpellum Stearnsii* was redescribed in 1891 as *S. calcariferum* by my lamented friend Dr. Paul Fisher (Bull. Soc. Zool. de France, April, 1891, p. 117).

It is likely that these " horns," while certainly inefficient as an armour for the thoracic region, may be protective in function, as their acute, projecting points probably could not be comfortably masticated. —HENRY A. PILSBRY.

The Orthoptera classified according to the characters of the Intestine.[2]—Continuing his studies upon the intestine and its appendages in the group of Orthoptera Bordas has made use of the facts in a classification of the group. The presence or absence of cœcal diverticula permits him to form two suborders, Colotasia and Acolotasia, and the number and arrangment of the Malpighian tubules allow him to decide each suborder into several families. Seven families in all are recognized. Until the first suborder, Acolotasia, distinguished by the absence of cæca the two families Phasmidæ and Forficulidæ are placed, which under the second suborder, Colotasia, the following five families are distinguished by the characters and in the order given:

(1) Blattidæ by a well developed gizzard, eight cæca, and by the Malpighian tubes being grouped in six fascicles.

(2) Mantidæ by a rudimentary gizzard and eight cæca, and by voluminous salivory glands.

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[2] L. Bordas. Classification des Orthoptères d'après les caractères tirés de l'appareil digestif Compt. Rend., CXXIV, 821–3.

(3) Acridiidæ by six cæca each with a posterior diverticulum and by the absence of a gizzard.

(4) Locustidæ by a voluminous gizzard with six rows of chitinous teeth, by two large cæca, and by the numerous Malpighian tubes opening at the summit of small conical tubercles.

(5) Gryllidæ by a large gizzard thickly armed with chitinous teeth, by two cæca, and by the Malpighian tubules being grouped into large fascicles that empty at the enlarged extremity of an efferent canal playing the role of ureter.

A Preserve of Black Foxes.—A few years ago a tourist, convinced that the extermination of the Black Fox was but a question of a few years at the most, purchased an island, Outer Heron, at the mouth of the Maine, off the port of Boothbay, with the intention of establishing there a colony of the animals in which he was interested. He imported from Alaska thirty individuals, only seven of which survived the long voyage. These were liberated on the island, which is well wooded and watered, and were provided with a guard, whose duty it is to look after the increase of the original seven. They are fed on horse meat, which is left in the forest for them, but they themselves forage along the shore for fish and mollusks thrown up by the sea. They live for the most part about the coast, seeking shelter in the clefts of the rocks.

The owner finds his venture quite a profitable one, having arranged with a London firm to dispose of the skins of the surplus of his pack. (Revue Scientif., Avril, 1897.)

D. G. Elliott and his party obtained 125 species of birds during their expedition through Somali-land. A list of these species has been compiled by Mr. Elliott, who subjoins each species named with the field note pertaining to it. The author gives much valuable information concerning the habits of these African birds. A new Kestral is described, *Cherchuis fieldii*, and 7 other new forms representing the families Turdidæ, Sylviidæ, Alandidæ and Ploceidæ. The latter family, however, has only a subspecies representative. (Pub. 17, Field Col. Mus.. Ornith. ser., Vol. I, No. 2, 1897.)

A resumé of the species of known Costa Rican mammals is given by J. A. Allen. The total number of species enumerated is 121, of these 10 species are domesticated animals, and 4 are introduced species of Mus, leaving 107 as indigenous to Costa Rica. (Bull. Amer. Mus. Nat. Hist., Vol. IX, 1897.)

Metamorphoses of Leptocephalus brevirostris.—A description of the transformation of *Leptocephalus brevirostris* into *Anguilla vulgaris* has been published by G. B. Grassi and Dr. Caulandruccio. The reality of the metamorphoses described has been confirmed by the characteristics of another specimen of *L. brevirostris* captured last January by Dr. Silvestri in the Straits of Messina. (1) The head and point of the tail has noticeably acquired the special characteristics of the eel. (2) The larval teeth have totally disappeared, while the distinctive ones seem entirely absent. (3) It lacks all traces of pigment. (Atti della Reale Accad. Lincei, VI, 1897, p. 239.)

ENTOMOLOGY.[1]

An Ant-Inhabiting Mite.—M. Charles Janet continues his interesting records of Myrmecophilous insects (Comptes Rendus, 1897, p. 583–585). His latest study relates to the peculiar mite *Antennophorus uhlmanni* and its host *Lasius mixtus.* The mite lives on the ant as an epizoön. "It fixes itself on the lower surface of the head or on the sides of the abdomen of its host by means of the carunculæ in which its feet terminate, and which are furnished with a very adhesive sticky substance.

These parasites are blind, but the first pair of feet is transformed into long antenniform appendages provided with very sensitive olfactory organs. They do not wander about in the galleries of the nest, but walks over the bodies of the ants, passing from one to another. When an *Antennophorus*, detached from the body of an ant, lies upon the soil in one of the galleries of the nest, it raises and stretches forward its first pair of ambulatory feet and at the same time it explores the space around it with its long antenniform feet. These appendages are much more agitated when an ant passes close by. If it pass near enough, the Acarid glues itself on to its body by means of the cup of sticky material on the end of one of its ambulatory feet, which it holds up ready for this operation, and it can in this way soon climb up and fix itself in a good position on its host. This latter is surprised, and seeks to rid itself of the new comer, but failing in this it becomes resigned very quickly as soon as the Acarid has taken up one of its normal positions.

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[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

Generally a working ant only carries a single *Antennophorus*, but they may very often be seen carrying several. In all cases the parasites take up positions symmetrical with the sagittal plane of their host's body, and it thus comes about that the center of gravity of the extra load is placed in the sagittal plane of the carrying ant.

The Acarids are also under the best conditions for not hampering the movements of the ants, and, as a consequence, for being the more readily tolerated by them. The *Antennophorus* directs its antenniform feet toward the front of the ant if fixed upon its head, and in the reverse direction if fixed upon its abdomen. When an ant carries but one *Antennophorus*, it is almost always placed on the head of the host. The case of an ant carrying an *Antennophorus* under its head and one on either side of the abdomen is very common. The presence of one or more of the parasites on the body of a Lasius does not prevent the latter from taking its share in the work of the colony and in particular the carriage of the larvæ and rubbish.

The *Antennophorus* attaches itself freely to the naked nymphs, but never to a nymph enveloped in a cocoon. Thus in an experimental nest consisting of some fifty ants, all carrying a single *Antennophorus* and accompanied by a certain number of nymphs, I found on the following day a newly emerged ant which bore seven *Antennophori* arranged symmetrically as follows: two (one on the top of the other) on either side of the head and on the abdomen, one on the middle of the dorsal region and one on either side. It would appear that the *Antennophorus* is attracted to the young ants on account of the care with which they are looked after and fed by their older companions. These latter do not seek to drive away the parasites which spread themselves a little later. At the moment when a queen throws off her nymphal envelope the workers come to her assistance, and as the workers carry the *Antennophori*, these latter generally take advantage of the position to pass over to the body of the newly emerged queen.

The *Antennophorus* feeds exclusively on the nutritive fluid disgorged by the ants. Fifty Lasii carrying *Antennophori* were placed in an observation nest and left without food. Eight days later the ants were in perfect condition, but ten or more *Antennophori* had already died of hunger. A tiny droplet of honey tinted with Prussian blue was allowed to run over the lower face of the glass plate which formed the roof of the nest. A large number of ants, nearly every one of which carried an *Antennophorus*, ranged themselves as closely as they could be packed all around the drop. The *Antennophori* had no share in the meal, and they were obliged to retire a little because there was no room for them between the heads of their hosts and the glass to which they were applied. The ants of this brood had acquired the habit of placing themselves, crowded one against the other, in one corner of the nest, and there they came with their crops well filled after the meal of blue-honey, and there they disgorged before the mouths of their comrades who had none. Now the ant in the act of disgorging opens its mandibles wide. The peristaltic movements of the æsophagus and the movements of the pharynx brought up the globules of honey, the blue color of which made them readily visible, and they formed a little drop in front of the mouth. While the fasting ant was eating the honey thus disgorged, the *Antennophorus* riding on its head took its share. To do this it pushed itself forward and thrust its rostrum into the droplet. Generally, while holding itself in position by means of the two hinder pairs of legs, it attached itself by means of the forward pair to the head of the disgorging ant. Very often, when the fasting ant had ended its meal and was retiring, one would see the *Antennophorus* try to keep its hold on the disgorging ant. The two Lasii generally lend themselves to this prolongation of the meal, and if they are slightly separated from one another, the *Antennophorus* stretches itself to its full length, and forms, back downwards a sort of bridge between the heads of the two ants.—*Annals and Magazine of Natural History.*

The Spread of the Asparagus Beetle.—In the recent Yearbook of the U. S. Department of Agriculture, Mr. F. H. Chittenden describes the distribution of *Crioceris asparagi* in America. He writes:

From the scene of its first colonization in Queens County, New York, the insect migrated to the other truck-growing portions of Long Island, and may now be found at Cutchogue, toward the eastern end of the island. It soon reached southern Connecticut, and has now extended its range northward through that State and Massachusetts to the State line of New Hampshire. Southward, it has traveled through New Jersey, where it was first noticed in 1868, eastern Pennsylvania, Delaware and Maryland to southern Virginia.

Its distribution by natural means has been mainly by the flight of the adult beetles. Undoubtedly, also, the beetles have been transported from place to place by water, both up and down stream by rising and falling tide, as the fact that it has not until recently deviated far from the immediate neighborhood of the sea coast and of large water courses near the coast bears abundant testimony.

Another reason for the present prevalence of this species in these localities is that asparagus was originally a maritime plant and has escaped from cultivation and grown most luxuriantly in the vicinity of large bodies of water. It is well known that it is usually upon wild plants that the insect first makes its appearance in new localities. There is evidence also that its dissemination may be effected by what Dr. Howard, who has made a special study of the distribution of this and other imported insect pests, has termed a "commercial jump," either by commerce in propagating roots, among which the insect may be present either as hibernating beetles or as pupæ, or by the accidental carriage of the beetles on railroad trains or boats.

Only by some such artificial means of distribution has it in later years found its way to northwestern New York, in four counties between Rome and Buffalo, and to Ohio, where it now occupies a similar territory of four counties between Cleveland and the Pennsylvania State line. During the past summer Dr. Howard traced its course along the Hudson River above Albany. Inquiry instituted by Mr. F. M. Webster concerning the Ohio occurrence disclosed the fact that the plants in one locality were brought from New York. Its presence in eastern Massachusetts in like manner may be due to direct shipments of roots from infested localities to Boston and vicinity.

It is noticeable that its inland spread, except in the neighborhood of water, has been extremely limited. It is present now in what is known as the Upper Austral life zone, although in certain points in New England it has located in what is considered the Transition zone. Its course up the Hudson River lies within a rather narrow strip of Upper Austral, and its location in the vicinity of Mechanicsville, about twenty miles north of Albany, marks its present most northern location. In all probability it is destined in time to overspread the entire Upper Austral zone and to make its way to some extent into neighboring areas in which it may find conditions for its continuance.

Notes.—In Bulletin 67, from the Kentucky Experiment Station, Prof. H. Garman discusses the San José Scale.

The Colorado Potato Beetle in Mississippi is the title of Bulletin 41 of the Experiment Station of that State. It was prepared by Mr. H. E. Weed, who shows that this pest is gradually approaching the Gulf Coast.

Mr. M. V. Slingerland treats of "The Army Worm in New York" in Bulletin 133 of the Cornell University Experiment Station.

W. M. Schöyen publishes (Entomol. Tedskrift, 1896, pp. 111–112) a short bibliography of Norsk Entomology for 1894–5.

Mr. Nathan Banks has described a number of new Neuroptera from North America (Trans. American Entomological Society, XXIV, 21).

EMBRYOLOGY.[1]

Some Activities of Living Eggs.—R. V. Erlanger[2] has published a brief account of the fertilization and the first cleavage stages of the eggs of several small Nematodes found in decaying earthworms; chiefly *Rhabdites dolichura* and *R. pellio.*

Some of the phenomena seen in the living eggs seem of special interest as adding to our knowledge of the amœboid power of egg protoplasm and at the same time furnish a welcome supplement to the results obtained upon the same and other nematode eggs by aid of reagents.

The sperm removed from the receptacle exhibits active amœboid movements at its conical end—the pseudopodia arise from folds that branch and anastomose and are capable of sudden, sharp bending movements at the free ends.

The egg shows active streaming currents in the protoplasm and amœboid movements at the end where the polar bodies are forming.

The egg nucleus moves rapidly towards the centre of the egg, apparently owing to the energetic streaming movements of the egg protoplasm, seen chiefly at the polar body end of the egg. This same end shows marked amœboid changes of outline that result in a deep furrow marking off from the larger end with the sperm nucleus a smaller blastomere-like end of the egg with the egg nucleus. The movement of the egg nucleus continues till it reaches the sperm nucleus lying at the pole opposite to the polar bodies.

A centrosphere appears and divides to form a spindle. The two nuclei coming together are flattened against one another and look like vesicles, each with a nucleolus. The spindle lies in the plane between the two nuclei and accompanies them as they slowly move toward the centre of the egg; the migration is accompanied by slow streaming throughout the entire egg and an obliteration of the external furrow that had marked off the egg into blastomere-like portions. In this migration toward the centre, the two nuclei stagger and turn somewhat, without losing their mutual relations of position.

At the centre of the egg the spindle assumes a position to coincide with the long axis of the egg and the two nuclei elongate parallel to it; astral rays become prominent from the ends of the spindle. The centrospheres swell and a swelling is conspicuous at the equator of the spindle (where reagents show the equatorial plate dividing) while the astral rays become very long aad *curved*, convex towards the egg surface.

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[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] Biologisches Centralblatt, XVII. No. 4, p. 152–160 and No. 9, p. 339–346.

The egg protoplasm now begins to move actively again in streams that set the spindle into slow pendulum-like movements. This streaming takes place alternately in each end of the egg and consists of movements from the pole toward the equator.

The cleavage plane appears suddenly as a groove on the surface of the egg at one side, and the internal streaming of protoplasm coming down from the pole towards this equatorial groove *turns inwards and then back towards the pole.* The same takes place on the opposite side of the egg, and the cleavage plane instantly cuts across through the egg.

Amongst unusual cases the author mentions the interesting fact that the movement of the protoplasm may temporarily bend the first cleavage spindle so much that its "fibres" become wave-like, while these same movements may make the astral rays twist into spirals, as seen by Mark in Limax. External pressure exerted on the eggs may bring about the same bending of spindle and rays. The author concludes that all the egg—spindle and astral rays included—is always plastic and liquid, though the material of the spindle of the rays is more viscid than the rest.

After the first division the larger of the two cells soon shows protoplasmic streamings again, and curious ridge-like pseudopodia rise up from its surface near the edge of the cleavage plane. Blunt pseudopodia may form on other parts of the surface, but the amœboid movements of the first two blastomeres are not as pronounced as those of the fertilized egg.

In the second division each cell shows streaming movements from the poles to the equator, and before the cleavage plane appears the spindle is seen to vibrate from side to side.

When the four cells are forming they glide over one another into a new arrangement, and in so doing they are much distorted by pressure—even the spindle within them being distorted.

The paper contains many other interesting facts regarding the cleavage phenomena, both as seen in living and in preserved eggs, but we will only note certain facts that speak for the view of Bütschli as to the vesicular or foam-like structure of protoplasm. Besides all the above facts that show the liquid and viscid state of even the most firm parts of the egg—the fibres—the author sees an appearance of vesiculation at times in the centrosomes, and the chromosomes may appear rather as hollow vesicles than as solid bodies. The general protoplasm, filled with yolk, showed in some cases a very fine net-alveolar structure in places. On the surface the alveolar layer of Bütschli was always present, and just after the cleavage a very plain cell-plate of Carnoy is regarded and figured by the author as merely the appressed alveolar layers of the two adjacent cells.

PSYCHOLOGY.[1]

Physiological Effects of Mental Work.—Within the present decade the relation between mental work and the bodily processes has been the subject of much study. Interest in the problem as a field for practical inquiry was first aroused by a paper on the fatigue resulting from intellectual work, published by Sikorsky in the *Annales d'hygiène publique* for 1879. He was followed more than ten years later by Burgerstein, Laser, Griesbach and others. In these investigations the method used was that of testing school children in classes. Various problems and exercises were set before them, during and after the school session, and the percentage of errors committed in the operations was taken as measure of the fatigue due to mental work. While some individual errors might be due to other causes, the average percentage of the entire class seemed a fair test of this factor. The latest instances of this method are the investigations of Friedrich and Ebbinghaus described in the May number of the NATURALIST. At about the same time Mosso and his pupils took up the question from another side. They instituted a series of laboratory investigations upon single individuals by means of the ergograph, with a view to determining the fatigue due to steady intellectual, as well as physical work. Kraepelin and his pupils meanwhile undertook the same problem, varying it with tests of the influence of various stimulants and narcotics on the capacity for mental work. They made use of the reaction time method, as well as the percentage of errors. More recently, Binet and his pupils have taken up the subject from a different standpoint, their object being to measure the effect of mental stimulation and mental effort on the bodily processes of breathing, heart action, etc. Several other investigators have studied the problem in one or other of these forms, among them may be noted Féré, Patrick and Gilbert, Frey, Bolton, Bergström and Henri.

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[1] Edited by Howard C. Warren, Princeton University, Princeton, N. J.

In an article in the *Année psychologique* for 1896, M. Henri gives a résumé of the various investigations and the methods used in each. He emphasizes the importance of distinguishing the different factors involved in both mental and physical work, and of studying each one separately by appropriate experimental methods. Among these factors he specifies in particular attention, voluntary effort, the psychic processes of memory, and imagination. Little progress has as yet been made in the way of investigating effort except in the study of pathological cases such as aboulia. As for attention, while considerable work has been done in this field, the investigations have generally had for end to determine the mental effects of fatigue and other variations in the conditions, rather than to measure the *physical* effects of variations in the *attention.* Memory has been, perhaps, more systematically studied than any of the other factors.

The investigation of the effect of intellectual work on the pulse and other functions which MM. Binet and Courtier have undertaken seems most likely, of all methods so far devised, to furnish a measure of psychical work in physical terms. A series of papers on the subject by these authors has appeared in the *Année psychologique*, the first in the issue for 1895, and four others in the last volume.[2] In approaching the question it was first of all necessary to study the effect of changes in respiration on the heart beat and blood supply. A large part of the first paper is accordingly taken up with this and with an examination of possible errors in the apparatus. The instrument used was the plethysmograph of Hallion and Conte. This consists of a rubber cylinder, which is grasped firmly by the hand. The outer surface of the hand is covered with a tight-fitting glove, so that any expansion in volume of the hand (due to increased blood pressure) takes effect on the inner surface, and results in diminishing the volume of the rubber cylinder; the latter communicates by means of a tube with a flexible drum. When the cylinder is compressed by the hand the drum rises, and the effect is recorded by means of a pen attached to the drum. The apparatus was found to be very serviceable, and was remarkably free from error. In addition to the frequency and strength of the pulse beat, the dicrotism, or break in the beat, was clearly marked in the diagrams, and proved an important factor in the results.

[2] Vol. III, 1896, published this spring.

MM. Binet and Courtier note the existence of important individual differences in the effects of mental work on the physical processes. In some subjects these are confined almost wholly to changes in the respiration, in others to the action of the heart, while in others they are felt more especially in the vaso-motor system. In general, the effect on the respiration is to make it more rapid and at the same time more superficial. The effects on the pulse curve most frequently observed are: 1st, diminution of amplitude; 2d, diminution of amplitude with change of form; 3d, diminution of amplitude, change of form and lowering of the level of the curve. One or other of these effects appear in almost all the subjects tested.

In their later papers the authors consider in turn the various causes of change in the pulse. They confirm the well-known diurnal changes by numerous observations with their own method, e. g., that the pulse becomes more frequent and the dicrotism generally more marked immediately after a meal. As regards physicial exercise, they lay special stress on the changes that occur in the dicrotism according as the exercise is local, general and moderate, or general and fatiguing.

The study of the effects of mental work is, of course, the most important from the psychological standpoint, and here the authors have sought to combine tests of the heart and respiration with those of the pulse. In addition to the more delicate tests, involving simple mental operations, two of the subjects undertook a piece of severe and prolonged mental work; they spent seven hours working steadily at this task, merely resting at the end of each hour for a time sufficient to perform the necessary tests. Comparing the results with those of a similar period passed under similar conditions but without work, the pulse was found to be considerably retarded in the former case, as compared with the latter, the retardation taking place especially in the early part of the period. The authors sum up their results on mental work as follows: "1. An energetic, but short mental effort produces an excitation of function, vaso-constriction, acceleration of the heart and of the respiration, followed by a very slight retarding of these functions; in some of the subjects a blunting of the dicrotism. 2. Intellectual work lasting for several hours with comparative immobility of the body produces a retardation of the heart and a diminution of the peripheral capillary circulation."

As regards the relation between physical and mental work, the authors are cautious in drawing conclusions. They observe a certain parallelism, in that a single energetic effort produces an acceleration of the heart and lungs, while a long-continued and fatiguing effort frequently weakens the dicrotism. On the other hand, the excitation of the heart is more marked and the acceleration of the respiration greater in physical than in mental work; again, in physical work the respiration grows deeper, while in mental work it becomes more superficial; and finally, prolonged mental work tends to produce a weakening of the peripheral circulation, an effect not observed in the experiments on physical work.

The effects of *emotion* on the heart and pulse are the topic of the last paper by the same authors. The experiments on this difficult problem were contrived with considerable ingenuity. Some of the subjects were children of from 8 to 10, in whom it was easy to excite fear, surprise, pleasure, etc. With adults the tests had to be more carefully planned; a false alarm of fire was prearranged in one case, and resulted in real fear on the part of the subject; another subject after being blind-folded had his hand placed on a pile of worms. A number of tests embodying various emotions were successfully made. It was found that every emotion tended to weaken the pulse; the quality of the emotion, whether pleasurable or painful, had no marked influence—the contrast was altogether between a state of mental rest and one of emotional disturbance. The heart showed a tendency to accelerate when the excitement was strong, and here too no difference was observable between the pleasant and the painful. The influence on the respiration was most marked of all; every emotional excitement produced an acceleration, and at the same time an increase in depth and a shortening of the pause.

The authors added a special study of the effects of music on these functions. Their experiments on this point were confined to one person—a man of fine musical appreciation and with considerable of a musical education; they represent, therefore, merely a single type of individual. There was found to be a distinct, though slight quickening of the respiration and heart in consequence of hearing the tones themselves, and apart from any emotional "echo" aroused by them. When a melody was played, whether sad or gay, the acceleration was more marked, and it reached a climax when the piece was of a dramatic character and particularly fitted to arouse emotion. This acceleration, however, was not accompanied by any noticeable irregularity. There was at the same time in general a weakening of the capillary circulation, which was less when the sounds had merely a sensorial effect than when they produced a distinct emotional disturbance.

In summing up the whole question of emotional effects on the bodily functions, the authors again lay stress on the differences among individuals. From their own observations they are inclined to distinguish three separate classes of effects. 1. In a majority of persons every emotion produces a vascular constriction, an acceleration of the heart and of the respiration, and an increase of amplitude in the thoracic cavity. 2. In some few cases a sensation of pain or an emotion of sorrow may produce a slight retardation of the heart; and 3. It is possible, as observations made on one subject prove, that the form of the capillary pulse may change with the quality of the emotion; this last effect, they remark, may in time enable us to make a classification of the emotions according to their physiological effects on the form of the pulse.—H. C. W.

ANTHROPOLOGY.[1]

Observations on the Scapulæ of Northwest Coast Indians.—Researches on the scapula since the time of Broca's[2] paper in 1878 have not been very numerous or conclusive in their results, and it seems fair to say that the valuable ethnic results which it was expected would be derived from extended observations on the scapula have not proved entirely satisfactory. Nor does it yet seem possible to say whether this is due to the insufficient numbers of scapulæ which have been examined or to individual variation. From an examination of the literature on the subject, especially from the papers of Sir William Turner[3] and Professor Dwight,[4] one would infer that the latter reason is the chief cause for the unsatisfactory results. Indeed, Professor Dwight declares,[5] "I do not know what range of variation a great series of the scapulæ of the larger felidæ might present, but a small one shows nothing like that of the human race—I might even add, that of the Caucasian." It must be confessed, however, that the numbers of observations so far made have been exceedingly small. This is to be explained, of course, in large part, by the fact that even in fairly well preserved skeletons the scapula is extremely likely to be more or less damaged.

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[1] This department is edited by H. C. Mercer, University of Pennsylvania.

[2] "Sur les indices de largeur de l'omoplate chey l'homme," etc., Bull. de la Soc. d'anthropologie de Paris, Feby. 21, 1878.

[3] Challenger report, Zoology, Vol. XVI, "Report on the Human Skeletons," p. 81.

[4] "The Range of Variation of the Human Shoulder-blade," AMERICAN NATURALIST, July, 1887.

[5] "The Range and Significance of Variation in the Human Skeleton," Boston, 1894, p. 23.

With the view of testing some of the conclusions of Professor Dwight, chiefly for my own satisfaction, I made a hasty examination of the scapulæ of the Northwest Coast Indians in the Field Columbian Museum. I was at once surprised at the apparently great individual variation in the general form of the bones, in the surfaces, borders, angles, etc. I then became curious to know if the indices would show a variation correspondingly great. In all I found twenty skeletons, the scapulæ of which were sufficiently well preserved to warrant an examination. Of these, thirteen were of the Kwakiutl race, seven being males and six females; and seven were Songish, four being males and three females.

I have studied topically the following subjects: I. Glenoid cavity; II. Borders and angles; III. Dimensions; IV. Indices; to which is added a general summary.

I. GLENOID CAVITY.

My interest in the glenoid cavity was confined to a sexual study of comparative size, and for this purpose two measurements were taken, the maximum length and the maximum width. I made no distinction of race in this study, and measured the cavity of the right bone only. In Table I are given the individual measurements of twenty specimens.

TABLE I.

Males.		Females.	
Length.	Breadth.	Length.	Breadth.
41 mm.	30 mm.	35 mm.	26 mm.
42	33	34	25
45	28	35	25
44	35	37	26
40	30	35	25
43	30	37	27
40	31	34	24
40	29	34	26
41	31	37	28
40	29		
40	28		

The sharp line of demarkation between the two sexes is perhaps better shown in the following table, where the comparative distribution of the measurements can be seen at a glance:

TABLE II.

Length.	Males.	Females.	Breadth.	Males.	Females.
34 mm.		3	25 mm.		4
35		3	26		3
36			27		1
37		3	28	2	1
38			29	2	
39			30	3	
40	5		31	2	
41	2		32		
42	1		33	1	
43	1		34		
44	1		35	1	
45	1				
Total,	11	9	Total,	11	9
Mean,	41.4	35.3	Mean,	30.3	25.7

Or, to put the result in still another form, we may say the glenoid cavity in the male measures 41 x 30 mm., in the female 35 x 25 mm. According to Professor Dwight the average length in the European male is 39.2 mm., in the female 33.6 mm.

II. BORDERS AND ANGLES.

a. *Superior Border.*—The superior border necessarily includes a portion of the vertebral border, or at any rate so much of it as is included in the superior angle. As there is no peculiar variation, so far as I can see, which is characteristic of either sex, or is confined to either the Kwakiutl or Songish, I have put into a single group some of the extreme forms. Naturally the chief interest in the superior border centers in the definiteness of the supra-scapular notch. As may be seen in Figure 1 there is an insensible gradation in the series, passing a gradual parabolic curve with no indication of a notch to a well defined notch. Another point to be noted is the very open superior angle which prevails with very few exceptions, and forms a marked contrast to the characteristic pointed termination of the European shoulder-blade.

b. *Vertebral Border.*—Again, as for the superior border, I have treated the collection as a whole, and reproduce here in Fig. 2 some varieties, drawing upon the entire series:

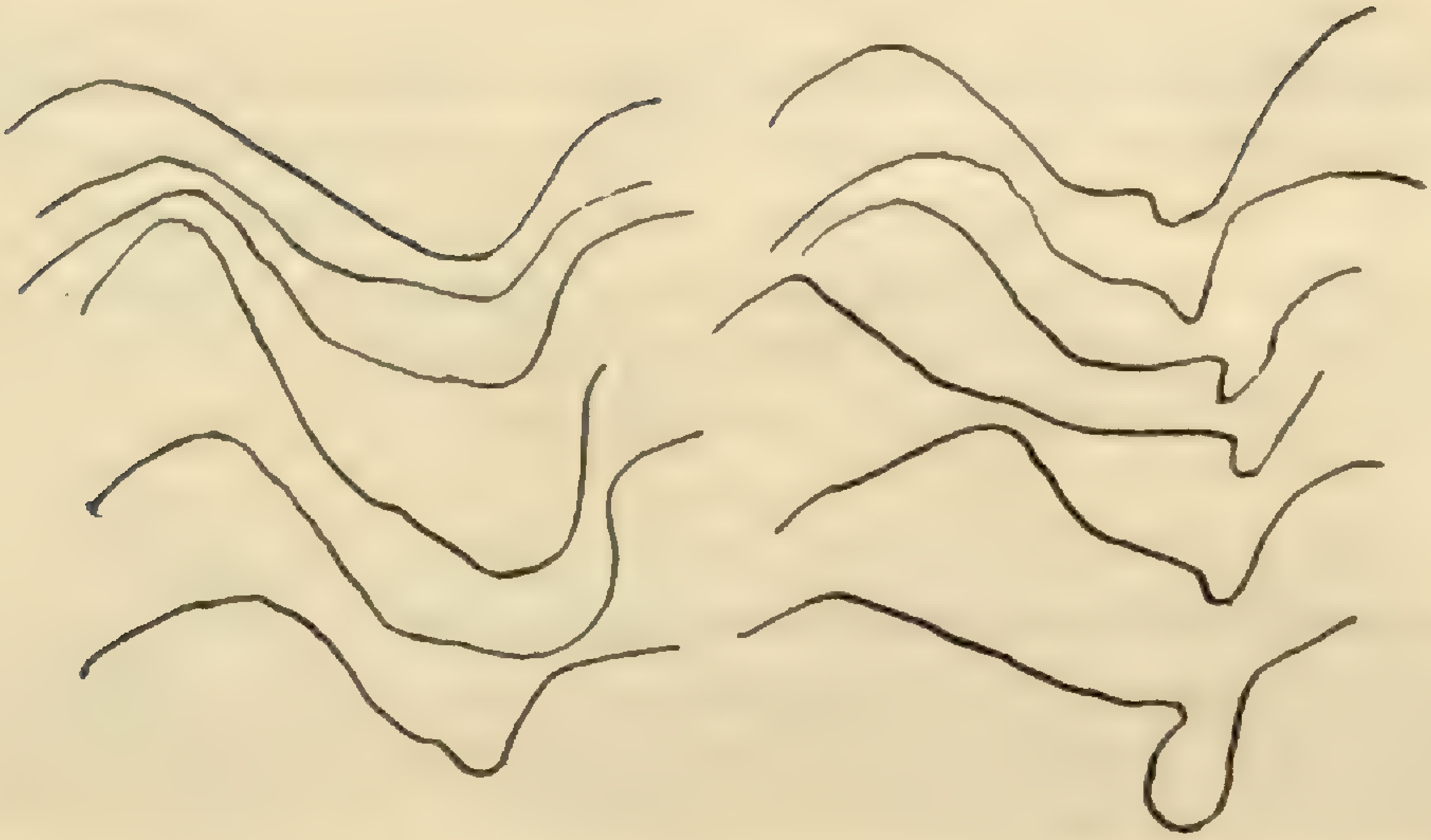

FIG. 1.—Variations in the Superior Border of the Scapula in Northwest Coast Indians. (One-half natural size.)

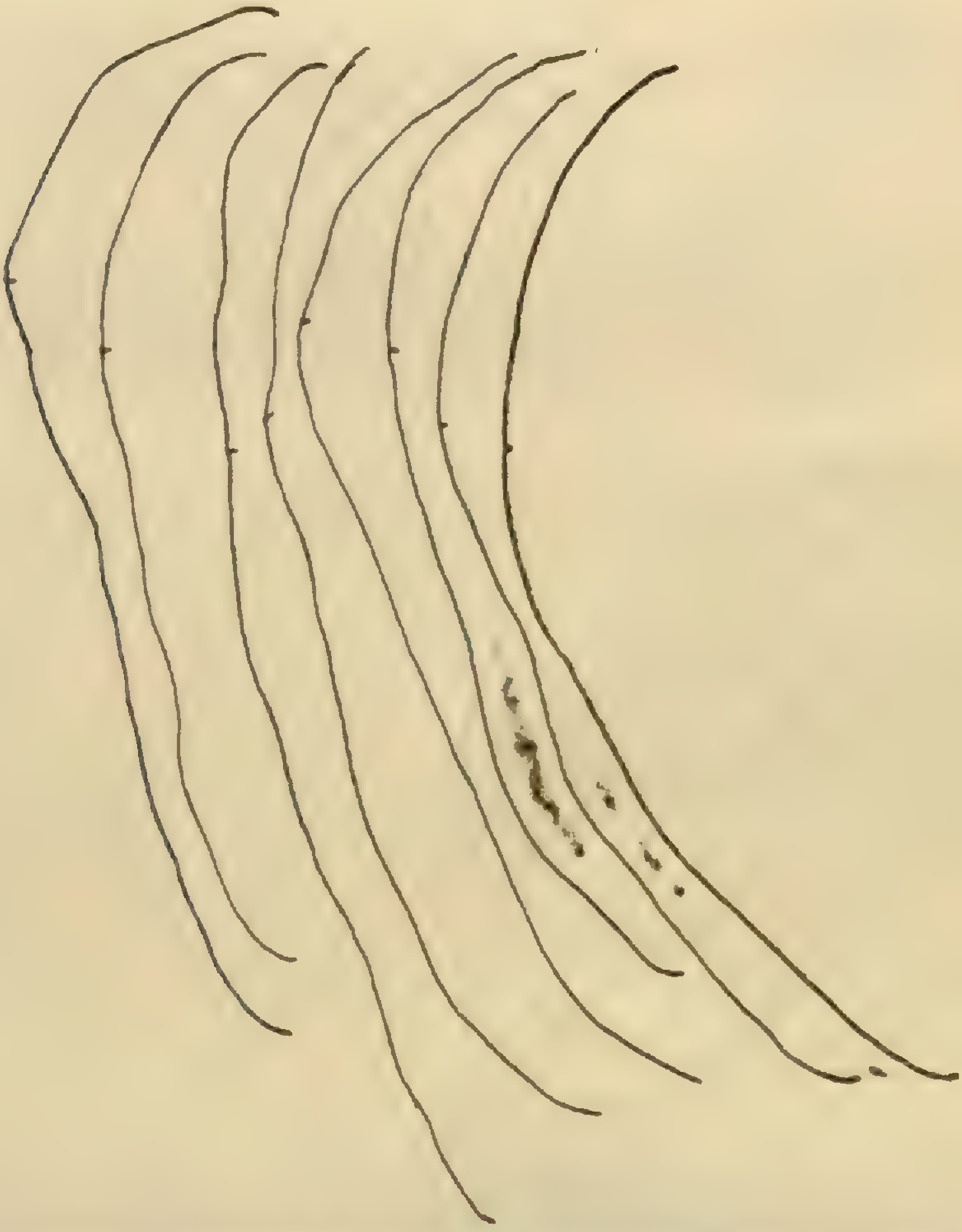

FIG. 2.—Vertebral Border of Scapulæ of Northwest Coast Indians. (One-half natural size.)

c. *Axillary Border and Inferior Angle.*—The variation here equals or even exceeds that of the superior border. This, as is well known, is due very largely to the variations in the attachment surface for the *teres major* muscle. As Professor Dwight here pointed out, this surface is prolonged after the nature of a spinous process in many of the lower monkeys, and has been considered by him as " the appearance of a peculiarity of lower forms"—analogous to the third trochanter. This opinion is, I believe, not generally held by anatomists, the majority preferring to regard the process, when present, as due solely to the influence of an unusually well developed *teres major* muscle. There being thus an unusual amount of interest in this region I have reproduced the outlines (see Figs. 3 and 4) of all the Kwakiutl and Songish scapulæ, keeping the two sexes distinct.

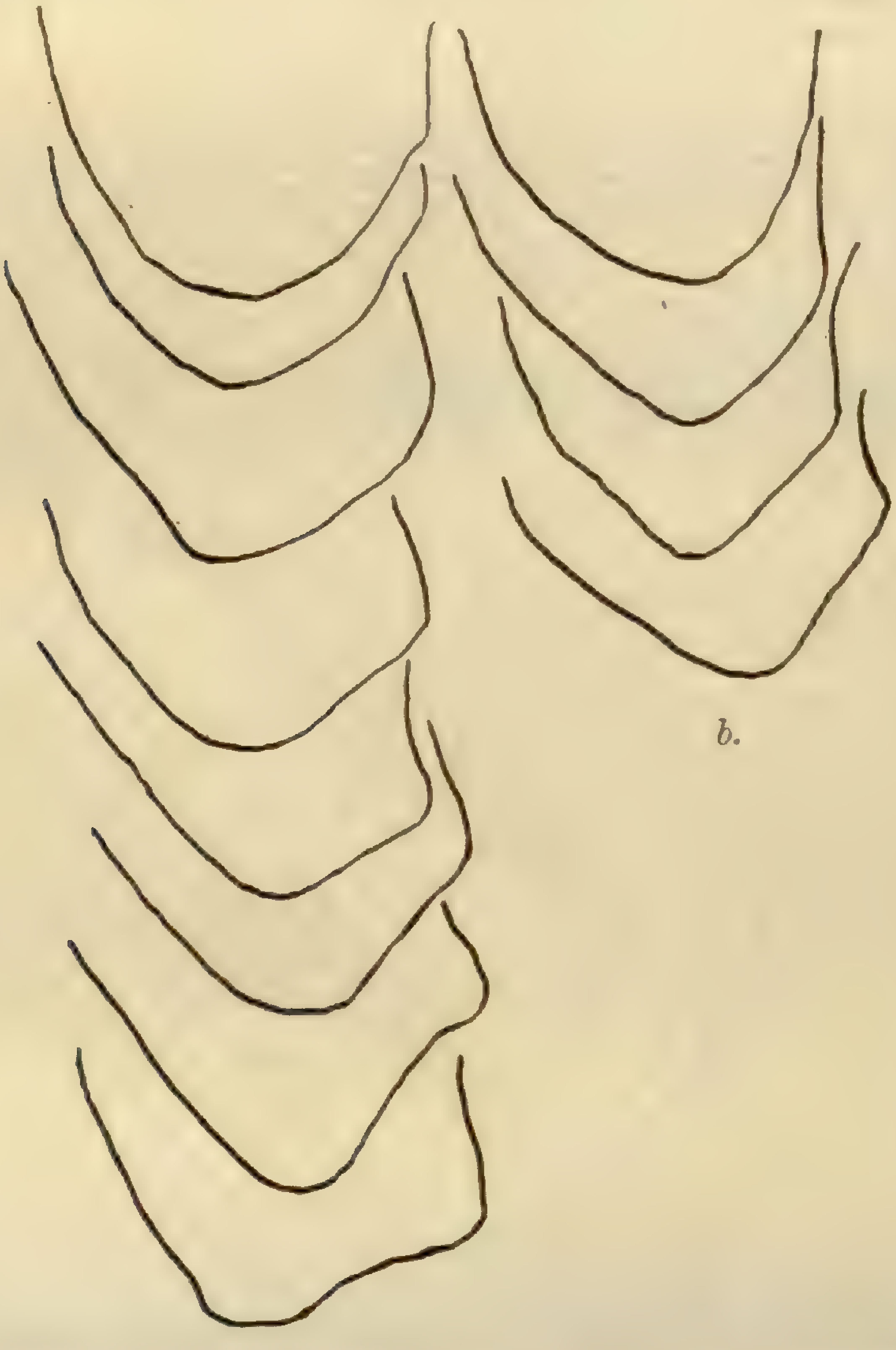

FIG. 3.—Inferior Angle of Scapulæ of Kwakiutl Indians. (One-half natural size.)—*a.* Males. *b.* Females.

It may first be noted in regard to these two sets of outlines that the inferior angle itself is extremely variable. But I entirely agree with Professor Dwight in thinking that the value of the results obtained from measuring it are not in proportion to the time necessary for the work, and this in addition to the difficulty of not being at all times sure of the results, especially when the axillary border is irregular in its course, as it very often is. This angle is said by Mivart to be about 35°–40° in European scapulæ; it certainly averages much higher in the series under consideration.

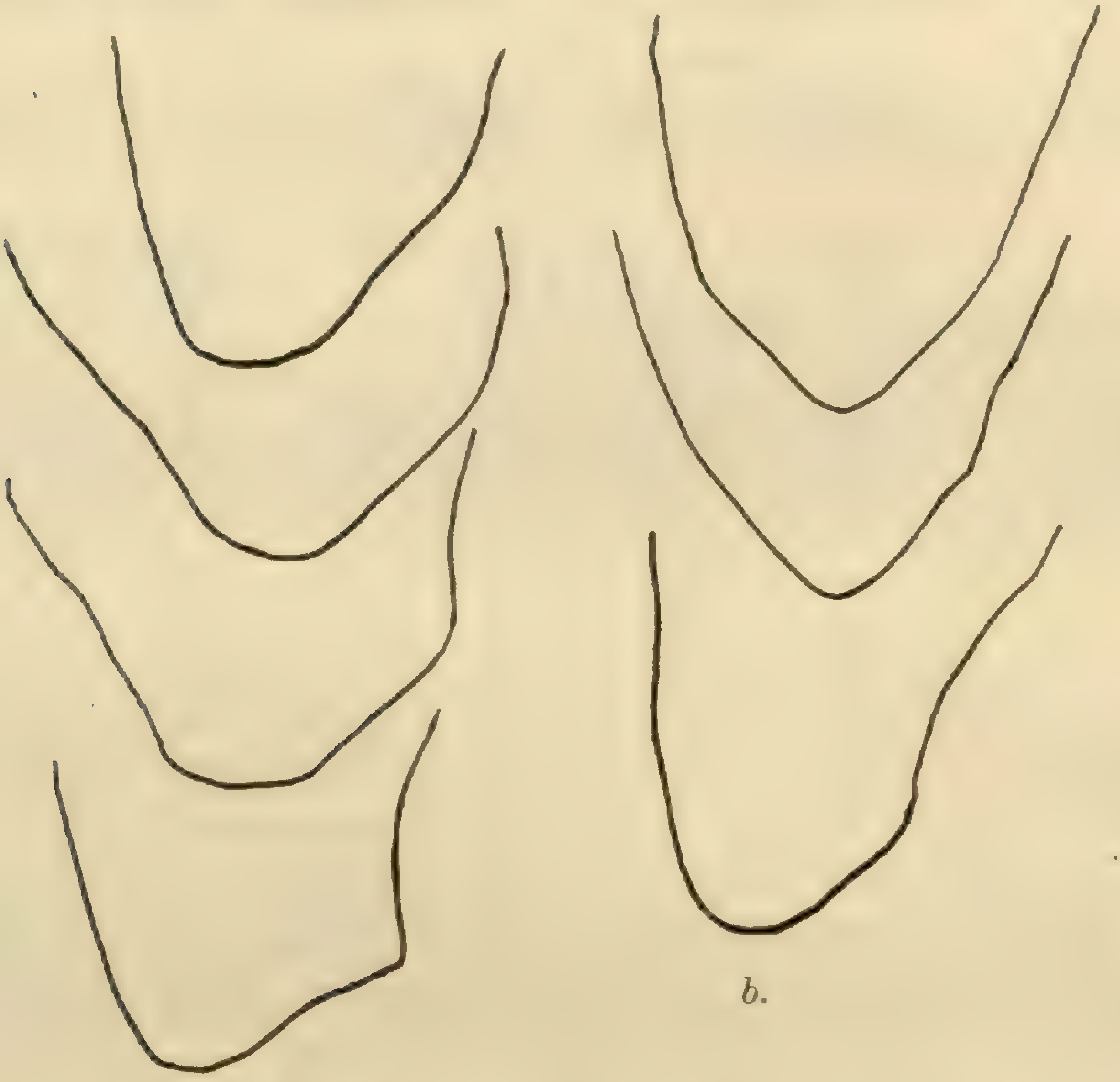

FIG. 4.—Inferior Angle of Scapulæ of Songish Indians. *a.* Males. (One-half natural size.) *b.* Females.

In regard to the teres major spine, it seems to be fairly constant in its development in the Kwakiutl males, about equally well developed in the Kwakiutl females and Songish males, and only faintly indicated in the Songish females.

III. DIMENSIONS.

I was interested in four points in the dimensions of the scapulæ, viz.: (a) individual variation; (b) lateral variation; (c) sexual variation; and (d) ethnic variation. These may be seen in the following table.

TABLE III.

		Length.		Breadth.		Infraspinous Length.	
		Right.	Left.	Right.	Left.	Right.	Left.
Kwakiutl	Males.	165 mm. 160 160 160 177 159 169	165 mm. 161 — 160 177 164 169	104 mm. 110 100 109 — 102 107	104 110 94 107 — 104 104	128 mm. 121 126 122 — 127 133	124 mm. 121 — 125 — 125 133
	Females.	154 140 134 140 — —	154 130 138 — — —	99 93 84 95 — —	100 94 87 — 92 87	122 111 109 107 — —	122 110 109 — — 113
Songish	Males.	180 153 177 164	172 149 177 160	107 98 110 107	108 97 110 105	140 114 135 122	135 115 133 122
	Females.	188 144 133	133 — 151	95 101 95	95 — 95	107 111 111	101 — 115

a. *Individual Variation.*—Taking the entire series as a whole, the range of variation in length is from 130 mm. to 180 mm.; in breadth from 84 mm. to 110 mm.; the infraspinous length from 101 mm. to 140 mm. The greatest contrast is thus, naturally, found in the length, the longest bone exceeding by almost one-third in length the shortest.

b. *Lateral Variation.*—In five instances the right bone is longer than the left, the total aggregate additional length being 31 mm.; in four instances the left bone is the longer, the total aggregate additional length being 18 mm. Lateral variation in breadth occurs equally five times for each side, but the total aggregate additional breadth for the right bone is 14 mm., while for the left it is only 8 mm. For the infraspinous length the right bone is the longer six times, with a total of 20 mm., while the left is the longer in three instances with a total of 8 mm. Thus, it may may be seen that the number of instances where some dimension of the right bone exceeds that of the left is sixteen, while in twelve instances the right exceeds the right in some dimension,—a difference hardly so great as one might expect; and it is possible that a larger series of observations would quite overcome whatever difference seems to exist.

c. *Sexual Variation.*—Taking the scapulæ of the right side only and of the two races together we have the following results, which I have thrown into a Table:

TABLE IV.

	Length.		Breadth.		Infraspinous Length.	
	Male.	Female.	Male.	Female.	Male.	Female.
	mm.	mm.	mm.	mm.	mm.	mm.
Average,	165	141	105	94	125	111

It will thus be seen that the difference in the two sexes is a decided one, and a careful examination of the preceding table shows very few exceptions where the largest female scapula equals in size the smallest of the males.

d. *Ethnic Variation.*—Although the two series are hardly large enough to make it worth while to attempt to draw any conclusions, it would appear that the scapula in the Songish is very slightly larger than it is in the Kwakiutl. This difference is more pronounced in the males than it is in the females.

IV. INDICES.

In Table V the range of variation may be seen for each index, in each sex, and for both races.

The highest scapular index is 70, found in a Songish female; the lowest is 59, in a Songish male. The highest infraspinous index is 90, occurring both in a Songish female and a Kwakiutl male; the lowest is 76, in a Kwakiutl female. Apart from the extremes this table shows two very interesting points; the first is that there is very little sexual variation; the second is that while the scapular index is fairly uniform, the infraspinous index is subject to great variation. The averages of each index for both races are shown in Table VI,

The scapular index of 65.1 for the mean of both races may be regarded, it seems to me, as a trustworthy index for the Northwest Coast Indians. This index, it may be noted, corresponds very closely to that

TABLE V.

Scapular Index.					Infraspinous Index.				
In	Kwakiutl		Songish		In	Kwakiutl		Songish	
Index	♂	♀	♂	♀	Index	♂	♀	♂	♀
59			1		76		1	1	
60					77		1		
61					78				
62	1	1			79	1			
63	2				80	2			
64	1	1	1		81	1	1	1	
65					82				
66		1	1	1	83		1		
67		1	1		84				
68	2			1	85			1	1
69					86				
70				1	87			1	
					88		1		1
					89	1			
					90	1			1
Total,	6	4	4	3	Total,	6	5	4	3
Index,	64.6	64.7	64.0	68.0	Index,	83.6	81.6	82.2	87.6

TABLE VI.

	Scapular Index.	Infraspinous Index.
Kwakiutl,	64.7	82.3
Songish,	65.7	84.5
Both Races,	65.1	83.2

given by previous investigators for European scapulæ; the averages for the latter being 65.9 (Broca), 65.2 (Flower and Garson[6]), 65.2

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[6] "On the Scapular Index as a Race Character in Man," Journal of Anatomy and Physiology, Vol. XIV, p. 13.

(Livon[7]), and 63.5 (Dwight). The result is also similar to that obtained by Professor Turner, 65.0, on the scapulæ of nine Fuegians.

The mean infrascapular index of 83.2 does not seem worthy of much consideration, from causes which have already been mentioned. It may be noted, however, that according to the table given by Professor Turner,[8] this index is lower than any yet recorded for any race except the Eskimos, Hottentots and Tasmanians.

CONCLUSIONS.

From the present inquiry the following conclusions can be made:

1. There is a marked difference in the size of the scapula in the two sexes; this is seen in the dimensions of the glenoid cavity, and in the length, breadth and infraspinous length.

2. Lateral variations in the scapulæ in linear dimensions are so slight and so contradictory as to be explained perhaps as due to an insufficient number of observations. The right bone is, however, a trifle larger than the left in a small percentage of cases,—this percentage being larger than that of the left bone exceeding the right in size.

3. There is no important difference in the dimensions or indices of the scapula between the Kwakiutl and Songish.

4. There is very little difference in the two indices in the two sexes; the female, perhaps, having indices a trifle higher than the male. This is in accordance with the results of Livon. Broca, on the other hand, considered the male to possess the higher index.

5. The range of variation for the scapular index is not excessive, and there is a certain amount of uniformity in its distribution which makes the mean index of value.

6. The range of variation for the infraspinous index, while not extensive, is so evenly distributed as to destroy in part the value of its mean; and so it cannot be considered to have a value equal to that of the scapular index as representing the average for Northwest Coast Indians.—GEORGE A. DORSEY, PH. G., *Assistant Curator of Anthropology, Field Columbian Museum, Chicago.*

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[7] "De l'omoplate et de les indices de largeur dans les races humaines." Thèse, Paris, 1879.

[8] Challenger Report, Vol. XVI, "Report on the Human Skeletons," p. 81.

MICROSCOPY.

Schaper's Method of Reconstruction.[1]—The ingenious method of reconstruction that has been described by Dr. Schaper has considerable advantage over the older method of Born, now long a familiar one in embryological laboratories. The base line of the sections is not at a distance from the section of the object as in the old method, but, on the contrary, is in the edge of the section itself, so that it is always in view, even where the section is so large as to be scarcely included within the field of vision. And one may as safely say that it is fully, if not more accurate than the older method.

Schaper first saturates the embryo with paraffin to prevent its drying and shrinking during the second stage of the process. In this second stage the embryo is taken from the bath and the superabundant melted paraffin removed from it by means of bibulous paper. It is then fastened by a drop of paraffin to a perfectly white piece of bristol-board. This forms a background from which the object stands out in sharp contrast, and allows of a good photograph being taken, or of an accurate outline sketch being made of it with a camera. The photograph or sketch is supposed to represent the natural size of the embryo.

The object is then removed from the bristol-board and replaced in the bath. Next he draws a line on the sketch or photograph just touching the dorsal outline and another one perpendicular to the first just touching the head, thus including the figure within a right angle. A similar right angle is drawn on a piece of cardboard that fits into the imbedding box. The latter is filled with melted paraffin, and then with warm needles the embryo quickly and carefully arranged in the right angle to correspond as closely as possible with the position of the figure in the sketch. The usual process of hardening the paraffin is then gone through and the object is ready for sectioning.

Care is taken in sectioning to have the plane of sectioning perfectly perpendicular to the median plane of the embryo; and, of course, it is assumed that the embryo is as straight as possible. The thickness of 20μ is chosen for the sections as the best, since in thinner ones the internal structures are apt to be broken and thicker ones are not likely to be sufficiently transparent. Sketches of the magnified sections are made on paper, and these, or whatever portion of them may be mounted, later transferred to wax sheets. But a pencil point is first made on the dorsal side of the sketch in the median plane, and sometimes also one in the same plane on the outline of the surface of some central organ, such, for instance, as the neural cord (*r* and *m*, figs. 1 and 2).

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[1] Schaper, A. (97). Zur Methodik der Plattenmodellirung. Zeit. Wiss. Mikros., XIII, 4, 446–59.

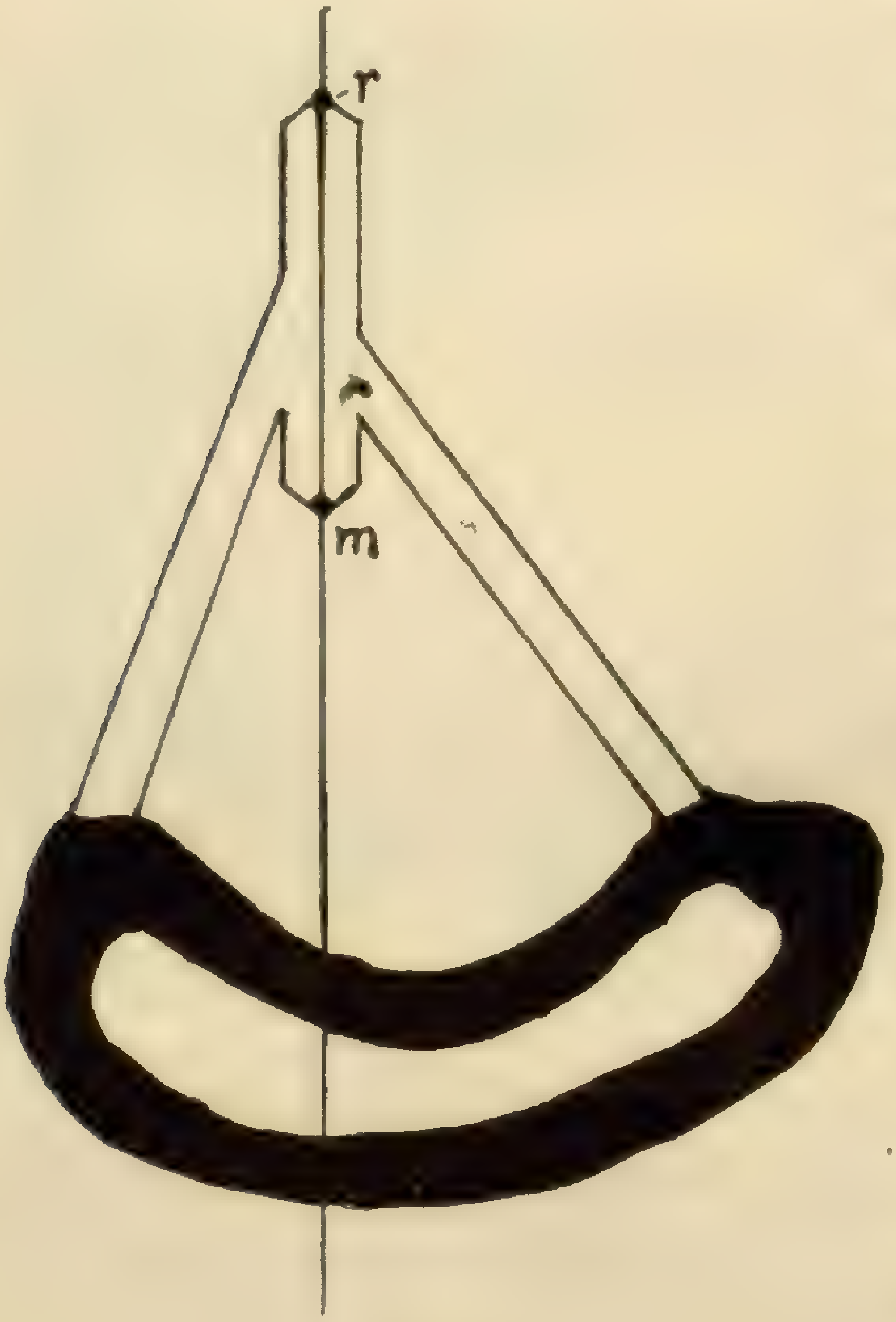

Fig. 1.

The photograph or sketch of the embryo is then enlarged upon a piece of bristol-board to correspond precisely with the magnification of the sections and the enlarged figure cut out with a sharp knife (fig. 2). If only an enlarged model of the entire embryo is desired, the remainder of the process is very short and simple. One has only to arrange the sections of wax representing the sections of the embryo within the bristol-board outline one after another and then smooth off outer surface with a warm modeling tool. If the sections are cut at right angles to the dorsal guide line of the right angle as well as to the median plane, the process will be easier to follow, for then the wax sections can be put in place with reference to this line. And if a model of only a portion of the embryo is desired, the proper place of the wax section in the bristol-board outline may be readily determined from the known thickness of the sections and the numbers in the series of the section with which the reconstruction is begun, by simply measuring off the proper distance on this dorsal guide line. For example, if the sections be 20μ thick, the magnification 100, the number of sections 100, and one desires to reconstruct the middle region of the embryo, beginning with the thirtieth section, the distance will be 20 x 30 x 100 or 60 mm.

If, as is usually the case, one desires a reconstruction of an internal organ, the process is somewhat more complicated. Then one will have need of the second guide point (*m*) already mentioned as on the surface of one of the principal or centrally located organs. In cutting out of the wax plates the outlines of the sections of the organ to be reconstructed, this point, along with that on the dorsal surface, is cut out so as each to form a point of a piece of wax that remains connected with the sections of the organ by bridges of wax (fig. 1). When the series of wax sections have been cut out, they are then arranged in the bristol board guide in their proper places, care being taken that the two guide points fall within the plane of the bristol-board, and that the line passing through them is perpendicular to the dorsal line of 4–2 (fig. 2). When all are in place, nothing further, of course, remains than to smooth off the outer surface of model.—F. C. KENYON.

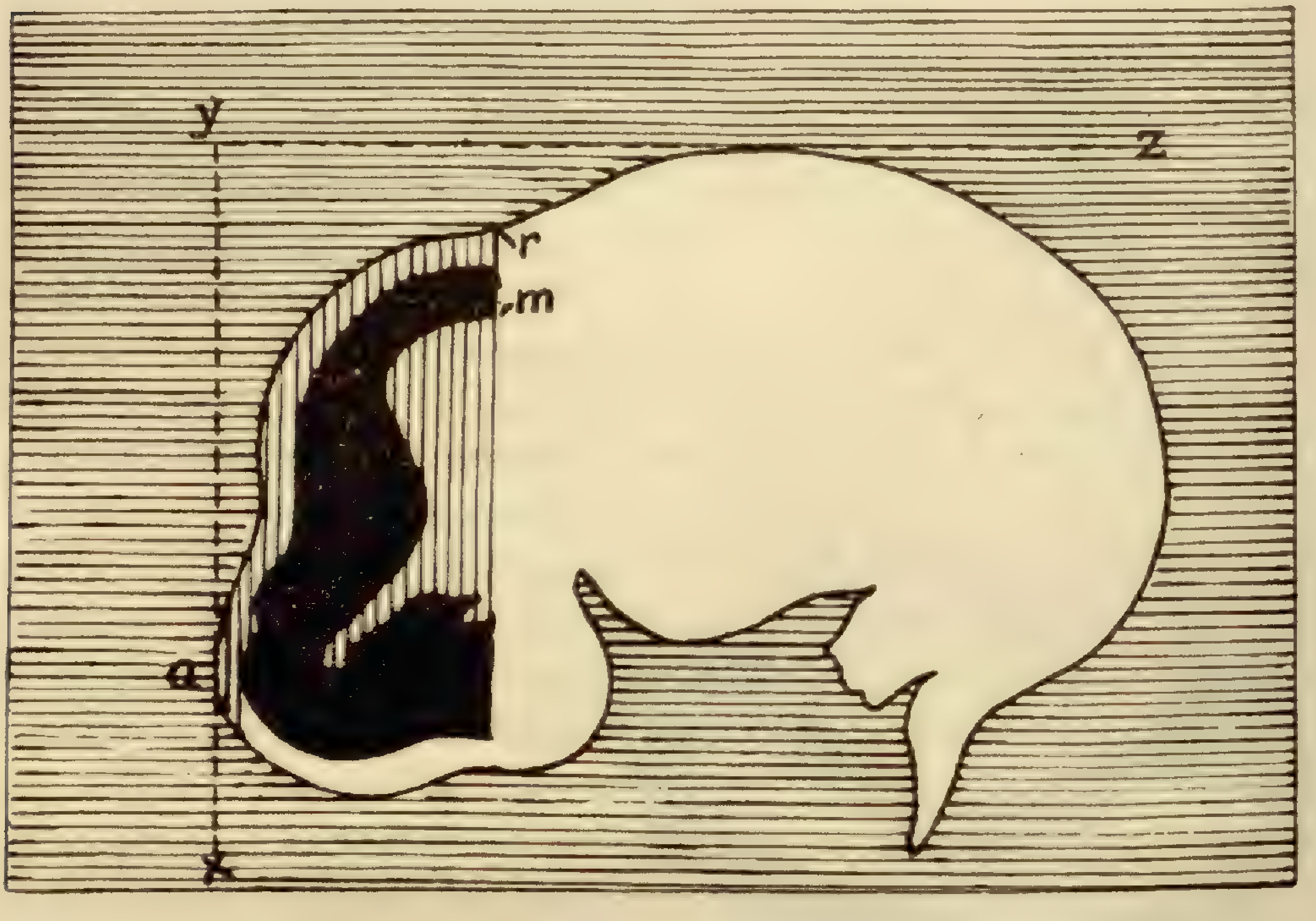

Fig. 2.

Fig. 2.—The Bristol-Board Guide. $x\,y\,z$, the dorsal and cephalic guide lines forming the right angle enclosing the figure of the embryo; r, the guide point in the dorsal surface and in the median plane; m, the guide point in the same plane on the lower surface of the neural cord.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Torrey Botanical Club.—May 11, 1897.—Dr. N. L. Britton presided. Three new members were elected. Three successful excursions were reported. Resolutions were adopted commemorating Dr.

Emily L. Gregory, the late honored Professor of Botany at Barnard College, an active worker in the club. Announcement was made of the gift by President Low to the Botanical Department of Columbia of a valuable set of water-colors to illustrate mushrooms, the work of the late lamented Wm. Hamilton Gibson.

Prof. Britton made a report relative to the progress of the Botanic Garden. A beginning is made in planting the systematic herbaceous garden. Eight acres are set aside for this with the families grouped in beds; the intention is to get as many of each genus together as will grow in this climate in the open. Several hundred species are already in place, and quite a display is already produced by the beds of the Ranunculaceæ, Compositæ, Iridaceæ and Cruciferæ. Seeds of some 3,000 different species are now germinating, including 2,240 species generously sent from Kew. These will be transferred to the herbaceous garden as soon as ready. Meanwhile their permanent stake-labels are in preparation.

The paper of the evening was by Mr. Marshall A. Howe, entitled, "A Preliminary Comparison of the Hepatic Flora of California with that of Europe and of the Eastern United States."

Mr. Howe alluded to the distribution of *Cephalogia turneri*, a rare hepatic of Europe, frequent in the coast ranges of California, and occurring in limited numbers in a few localities in Ireland, England, France and the Mediterranean region.

Mr. Howe presented the following table exhibiting the comparative distribution so far as yet known.

	California.	Gray Manual Reg.
Total number of species	77	145
In common with the British Isles	34 or 44 per cent.	78 or 54 per cent.
In central and northern Europe	40 or 52 per cent.	91 or 63 per cent.
In Mediterranean region	45 or 58½ per cent.	78 or 54 per cent.
Peculiar to Pacific Coast	26 or 34 per cent.	
In common with the Gray Manual Region	37 or 48 per cent.	
Peculiar to Gray Manual Region		40 or 28 per cent.
In common with California		32 or 22 per cent.

It was shown that the hepatic flora of California has more in common with northern and central Europe than with the eastern United States, and is still more allied to that of the Mediterranean region. In particular species of Astorella and Riccia are better developed in California and southern Europe than in the eastern United States.

The apparent absence in California of Bazzania and Mylia, which are especially characteristic of medial and boreal regions, serves to heighten the similarity to southern Europe.

The paper was followed by exhibit of photomicrographs of sections of Cryptomitrium, illustrating the development of the archegonia.

In the discussion following, Prof. Underwood said that Hepatic species are most numerous in the Amazon region and the eastern slope of the Andes and in Java. Insular tropical regions have furnished many where examined, as Cuba and Jamaica. Quite a number are peculiar to Australia. New Zealand is well-supplied with species. Many have been recently collected in Africa, and have been described by Herr Stephani, of Leipsic, whose industry has doubled the number of described Hepaticæ. As a whole, the maximum development of the Hepaticæ is tropical, though some genera and certain groups within genera are wholly high-temperate or subarctic.

Prof. Britton remarking the indications of circumboreal and circumtropical distribution of certain species, referred to the argument for an equatorial distribution of flowering plants and of ferns, and queried if there were anything corresponding among Hepaticæ. He expressed the belief that it is the immediate environment which at present exerts the principal influence on distribution, whatever the original cause or mode of distribution may have been.

Prof. Underwood referred to the influence of the Gulf Stream in permitting the existence of the subtropical genus Lejeunia on the coast of Ireland, a genus not elsewhere found in Europe. Comparing the Hepaticæ of Florida, they are only in part known ; a few species are in common with the Appalachian flora ; most of the Florida hepatica are close-creeping forms found on bark, as *Frullania* and *Lejeunia*, having water sacs on their leaves as aid in resisting drought. Some tropical *Marchantiaceæ* occur in Florida, and also, especially, species of *Riccia* and *Anthoceros*. *Thallocarpus* is known only from Florida and South Carolina. Adjourned to May 26.

MAY 26, 1897.—The President, Hon. Addison Brown presided. The evening was devoted to a lecture by Mrs. Elizabeth A. Britton, entitled " The Moss Flora of the Adirondack Mountains," illustrated by lantern slides prepared by Mr. C. H. Van Brunt, and also by about 150 mounted sheets displaying specimens collected by Mrs. Britton in the vicinity of Adirondack Lodge and Lake Placid in the years 1892, 1894 and 1896. Their various habitats were described, with the story of a climb up Whiteface. About 30 rare species were enumerated, including *Raphidostegium jamesii* not previously reported from New York

State, and *Bryum conciunatum*, found only once before in the United States. Duplicates of Mrs. Britton's collection have been deposited at the State Herbarium in Albany, the main collection having been presented to the Herbarium of Columbia University. Partial sets were sent to the Brooklyn Institute, Cornell University and other collections.

After discussion by Mr. A. P. Grout, Mrs. Britton and others, the Club adjourned to the second Tuesday in October, field-meeting continuing meantime on Saturdays.—EDWARD S. BURGESS, *Secretary*.

SCIENTIFIC NEWS.

The College of Agriculture of the University of California at Berkeley was recently destroyed by fire, the loss amounting to $20,000. The building was of comparatively little value as the department had outgrown it.

Natural Science again changes publishers. With the beginning of the eleventh volume this valuable journal will be issued from the press of J. M. Dent & Co., 67 St. James St., London.

Recent Appointments, America: Robert B. Yound, assistant biologist in the department of Agriculture; Frederick L. Ransome, assistant geologist on the U. S. Geological Survey; Herbert Richards, tutor in botany in Columbia University; Jas. H. McGregor, assistant in zoology Columbia University; Dr. Frederick D. Lambert, assistant in biology, Tufts College; C. H. Townsend, chief of division of fisheries, U. S. Fish Commission; Dr. H. M. Smith, chief of the division of scientific enquiry, U. S. Fish Commission; J. F. Crawford, demonstrator of experimental psychology at Princeton; J. H. Pratt, mineralogist to the North Carolina Geological Survey; T. A. Reakard, state geologist of Colorado. At Johns Hopkins University: Dr. J. M. T. Finney, professor of surgery; Dr. J. E. Humphrey, associate professor of botany; Dr. J. B. Shattuck, assistant in geology; Dr. C. R. Bardeen, assistant in anatomy; Mr. F. C. Connant, Bruce fellow in zoology; Mr. Cleveland Abbe, Jr., fellow in geology; Mr. G. A. Drew, fellow in biology; Mr. C. W. Greene, fellow in biology; Mr. J. L. Nichols, fellow in pathology. Other American appointments are: Dr. Charles E. Beecher, professor of historical geology at Yale University; Dr. L. V. Pirsson, professor of physical geology at the Lawrence Scientific school; Dr. Charles Norris, tutor in pathology at Columbia University; Dr. E. B. Copeland, assistant professor of botany at the University of Indiana.

Germany: Dr. K. von Buchku, director of the department of scientific enquiry at the sanitary office, Berlin; Dr. Jensen, privat-docent in physiology in the University of Halle; Dr. Max Siegfried, professor extraordinarius of physiology at Leipzig: Dr. Fritz Noll, professor of physiology at the University of Heidelberg; Dr. E. Kaufmann, professor of anatomy at Bonn; Dr. Max Walters, professor extraordinarius of anatomy at Bonn; Dr. Ludwig Heim, professor extraordinarius of bacteriology at Marburg; Dr. Noll, professor of botany at Bonn; Dr. Siedentopf of Göttingen assistant in mineralogy at Griefsorald; Dr. Beckenkamp, professor of mineralogy at Würzburg; Dr. E. A. Wülfing, professor extraordinarius of mineralogy at Lubingen; Dr. Paul Samassa, associate professor of zoology in the University of Heidelberg.

Austria: Wladislow Szymonowicz, professor extraordinarius of histology and embryology at Lemburg; Victor Folgner, assistant in the botanical institute of the German University of Prag; Anton Heinz, professor of botany at Agram; Dr. Mijat Kispatitch, professor of mineralogy at Agram.

Great Britain: F. F. Blackman, lecturer in botany at Cambridge.

Other Countries: Dr. J. L. Prevost, professor of physiology at Geneva; A. Gibb Martland, of the Innusland Geological Survey, geologist of West Australia; Dmitri Klemenz, Curator of the Museum of the Petersburg Academy of Sciences; Dr. Velain, professor of physical geography in the University of Paris.

Mr. A. Smith Woodward, of the paleontological department of the British Museum presents an appreciation sketch of the late Professor Cope in the June number of Natural Science.

The Academy of Natural Sciences of Philadelphia, is trying to raise $50,000 to purchase the paleontological collections of Professor Cope. Since the fund received from the sale of the collections is to go to the Academy for the foundation of a professorship of paleontology it would seem appropriate that the collections themselves should become the property of this society.

Fritz Müller, well-known for his investigations upon the history of the white ants, the embryology of Crustacea and especially for his suggestive little volume "Für Darwin" died at Blumenau, Brazil, May 21, 1897, at the age of 75.

Dr. John Murray had just opened a new biological station at Millport, on the Clyde.

Prof. Jacob G. Agardh, of Lund, the well known student of sea weeds, secures the gold medal of the Linnean Society of London.

From *Science* we learn that the United States Geological Survey has appropriations for the present fiscal year as follows: The topographical surveys $175,000; for geological surveys and researches $100,000; for investigation of coal and gold in Alaska $5,000; paleontology $10,000; chemistry $7,000; gauging streams and water supply, $50,000; numeral resources $20,000. Besides there are allowances for illustrations, printing, etc. The same bill also appropriates large sums for other surveys of the public forest lands; Indian Territory, etc.

The Museum at Bergen, Norway, has for several years been very active and now is to be enlarged, the government furnishing half of the $40,000 required for the addition. Over 50,000 people visited the museum in 1896.

The Field Columbia Museum of Chicago, has purchased the Schott collection of plants.

We have often had occasion to speak of appointments to scientific office in the State of Indiana and Illinois. Illinois has again emphasized the domination of the politician in these matters by the appointment of a steamboat agent, Mr. C. H. Cranz, to the office of State Geologist and curator of the state museum; while Kentucky is adopting a similar course if the recent appointment of G. W. Stone, a lawyer and a politician, to be inspector of mines be any criterion.

Natural Science makes the astonishing statement that the tanks of the Port Evin Biological Station now contain "a cross between Myxine and the cod."

Recent Deaths: Max Sintenis, entomologist at Kupferberg, Silesia; Filipps Tognini, curator of botany in the University of Paris; M. Thollen, botanist, at Libreville, Africa, in January; G. Gercke, student of diptera at Hamburg; J. B. Barla, director of the Museum at Nizza; Dr. Julius Sachs, professor of botany in the University of Würtzburg; Sir Edward Newton, ornithologist; Abraham der Bartlett, superintendent of the London Zoological Gardens.

An important change has been effected at the National Museum by which the various departments of the institution have been divided into three sections—anthropology, biology and geology. The object is to secure a more simple administration of the museum's affairs.

Head curators, each with a salary of $3500 a year, have been appointed from the present museum personnel, as follows: Anthropology, Professor W. H. Holmes; biology, Dr. Frederick W. True, executive curator of the museum, which office he will also retain; geology, Dr. George P. Merrill, Professor of Geology in Columbian University.

A herd of some seventy or eighty buffaloes has been discovered in the northwestern part of Buchel County, Texas.

Trinity University, of Toronto, Ont., has offered the honorary degree of D. C. L. to the following members of the British Association: Sir John Evans, President of the association; Lord Rayleigh, Lord Lister, Sir John Lubbock, and Prof. Forsythe, of Cambridge.

The viticultural services of the late Professors P. Duchartre and F. Laforgue are to be commemorated by marble plates in the houses in which they were born. Both were born in the neighborhood of Béziers. The former in 1806.

Mr. A. W. Bennett has been appointed by the council of the Royal Microscopical Society to edit the well known journal of the society previously edited by Prof. F. J. Bell.

Dr. C. A. White and Mr. Charles Schuchert have gone under orders from the U. S. National Museum to join the Peary expedition to the Arctic regions. Their party will be put ashore at Disco island to explore the island for fossils, while awaiting the return of Lieut. Peary's vessel.

Mr. Currie, who accompanied Prof. O. F. Cook to Liberia, Africa, has returned, and reports that a large collection of insects and animals has been made. Prof. Cook is expected in August.

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THE

AMERICAN NATURALIST

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BIOLOGY AND MEDICINE.[1]

BY WILLIAM H. WELCH, M. D., LL. D.

It is a great pleasure to bring hearty congratulations to the University and the city of Chicago upon the completion of the Hull Biological Laboratories. This University, the offspring of unexampled private munificence, marvellous in its birth and infancy, and clearly destined to great achievements for education, for science and for humanity, may well rejoice upon this occasion, but Miss Culver, by her beneficent gift, has earned the gratitude not of this University alone, but of all interested in the progress of the biological sciences. A gift of such magnitude as this one, devoted to "the increase and spread of knowledge within the field of the biological sciences" is of far more than any local significance. It must awaken the cordial interest far and near of those who understand the scope and meaning of the sciences of organic nature. What is here planned and has already been accomplished, gives assurance that the wishes of the donor and the expectations of others will be amply fulfilled, and that in these laboratories in unusual measure will knowledge of the forms and activities of living things grow and hence be diffused.

[1] Address delivered at the dedication of the Hull Biological Laboratories at the University of Chicago, July 2, 1897.

Laboratories are now so universally recognized as essential for the systematic study and advancement of all physical and natural sciences, that we can hardly realize that they are almost wholly the creation of the last three-quarters of the present century. With the awakening of scientific thought in Western Europe in the fifteenth and sixteenth centuries, natural phenomena again began to be studied by those methods of exact observation and experiment which had received their last fruitful application centuries before in the hands of the natural philosophers and physicians of Greece and Alexandria. For the purposes of such study, learned academies and societies were founded, botanical gardens were planted, explorations and collections of natural curiosities were made, apparatus was devised and individual investigators had their scientific workships. All of these material circumstances greatly promoted scientific inquiry and discovery, but with one exception they did not lead to the formation of laboratories freely open to students and investigators. The exception was the establishment of laboratories for the study of human anatomy.

It is of no little interest, both for the history of biology and for that of science in general, that the first laboratory for the training of students was the anatomical laboratory. For over six hundred years there has been at least some practical instruction in anatomy, and for over three hundred years there have existed anatomical laboratories for students and investigators. Until the end of the first quarter of the present century there was no branch of physical or natural science, with the exception of anatomy, which students could study in the laboratory. Only in this subject could they come into direct personal contact with the object of study, work with their own hands, investigate what lay below the surface, and acquire that living knowledge which alone is of real value in the study of natural science.

The era of modern teaching and investigating laboratories was ushered in by the foundation of one devoted to another of the biological sciences. In 1824 Purkinje established a physiological laboratory in Breslau which antedated by one year Liebig's more famous chemical laboratory in Giessen. This latter, however, which is usually, and, as we have seen, not quite correctly, considered to be the first of modern teaching laboratories, exercised the determining influence upon the establishment and organization of scientific laboratories in general. The significance of Liebig's memorable laboratory is that it provided a place, furnished with the needed facilities and under competent direction, freely open to properly prepared students and investigators for experimental work in the entire field of the science to which it was devoted. Such an impressive illustration of the value of laboratories for instruction and research could not fail to be followed by other departments of science. In this movement for the establishment of laboratories, Germany has been from the beginning the leader, and by their instrumentality she has secured the palm for scientific education and discovery.

We owe especially to Louis Agassiz the introduction into this country, fifty years ago, of laboratory methods in biological study, but it is only within very recent years that nearly the whole field of biology has been represented among us by laboratories worthy of the name. To the small number of suitably equipped biological laboratories existing in this country those whose opening we are assembled to celebrate, make a most notable addition, unsurpassed, I believe, in construction, in equipment, in plan of organization, and in opportunities for scientific work.

Modern laboratories have completely revolutionized during the past half century the material conditions under which scientific work is prosecuted. They have been the great instrument of the unexampled progress of the physical and natural sciences during this period. Their educational value cannot well be overestimated. They impart, or should impart, to the student something of the scientific habit of thought which is no less valuable in daily life and in other pursuits than in science. At the present day no University can hold even a respectable place in the march of education and progress unless it is provided with suitable scientific laboratories, and it is one of the glories of this University that this conception prevailed and bore fruit at its inception. The establishment and support of good laboratories require large outlays of money, and it is chiefly this requirement which calls for endowments of Universities far surpassing anything needed but a few years ago. But the benefits to mankind derived from such endowments outweigh, beyond all computation, the money expended which, as has been truly said, is "a capital placed at a high rate of interest."

One sometimes hears the remark, and it is of course true, that large endowments, palatial buildings, splendid laboratories do not make a University. The breath of life, the vitalizing principle, must come from those, both teachers and students, who work within their walls. If the phenomena of nature could be learned by contemplation and by hearsay, that famous University which consisted of a log with Mark Hopkins at one end and the student at the other, might exist somewhere outside of the imagination. But knowledge of nature is not to be acquired otherwise than by observation and experiment, for which the facilities at the end of a log are somewhat inadequate. The great teachers and investigators are likely to be attracted to those Universities where the resources and opportunities for their special work are the most ample.

Laboratories are only workshops; that which is of vital importance is what is done within them. Provision has been made in the Hull Laboratories for the cultivation of all departments of what is ordinarily called biology. The domain of biology embraces all living things, both vegetable and animal. Of vital manifestations it is only some of the mental operations and doings of human beings which the biologist at present excludes from his survey, and even this self-sacrificing curtailment of his province may not be enduring.

The main directions of biological study relate to the forms and anatomical structure, however minute, of living organisms, to their functions or activities, to their developmental history, both individual and ancestral, to their systematic affinities and classification, and to their distribution over the globe in present and in former geological epochs. This vast field of study is far more than can be compassed by one man, however versatile and industrious, or in one laboratory. It necessitates such specialization and subdivision of labor as is represented by these laboratories and by those appointed to conduct the work in them.

All that relates to the vegetable kingdom, whether it be anatomical, physiological or paleontological, is included under botany. The historical development of this science has been far more consistent and symmetrical than that of animal biology. In the latter the central position is appropriately occupied by zoology in the widest sense. Unfortunately the term zoology has not had the same comprehensive meaning in reference to animals that botany has in reference to plants, but there is a growing tendency, which I am glad to see is here recognized, to include under the designation "zoology" more and more of animal biology, and especially to discard the artificial distinction between zoology and comparative anatomy, a distinction which can be traced historically to the early development and exceptional position of human anatomy, to which I have already alluded. Not less important than the study of organized form and structure, and inseparably intertwined with it, is that of physiology, which concerns itself with the properties and actions of living beings. Subordinate to physiology, but still deserving recognition as a specialized biological science, is physiological chemistry, which is most fruitfully cultivated by one trained both as a chemist and as a biologist, who gives his whole time to the subject. The study of the structure and functions of the nervous system has become so specialized and has such important relations to psychology, that neurology has here received special recognition as a separate department. The same is true of paleontology, which forms a connecting link between biology and geology, and which has shed most valuable light upon fundamental problems concerning the origin and development of animals and plants.

There are some who see in the setting up of all of these divisions and subdivisions of biological science peculiar perils resulting from the severance of natural relations and loss of perspective. This is the familiar cry of the general worker against the specialist, a cry which, however loudly uttered, will not be heeded. Where proper organization exists, I do not share these apprehensions. The principle of specialization and subdivision of labor has been the great factor in scientific progress. Whenever a body of scientific knowledge has reached a stage of development in which its extent is considerable and its problems and the methods of attacking them are special, it is convenient and proper to recognize it as a branch of science whose interests will be best furthered by workers specially trained to its service.

But while conceding to the fullest extent the practical benefits which attend the separate cultivation of different departments of biology, I would even more strongly emphasize the essential unity of the biological sciences. In essence these sciences constitute but one science, and the great service of the word "biology" in its present use is to embody this conception. The fundamental problems everywhere in biology are the same, the determination of the structure and the properties and the laws controlling them of living matter. In whatever department knowledge be gained as to these fundamental questions, it is a contribution to all departments of biology. The expansion of our knowledge brings closer together all physical and natural sciences, physics with chemistry, and both with biology. It is of incalculable advantage that the surfaces of contact between the different branches of biological study should be kept clearly in view, and that knowledge gained by one should be made readily available for others. Hence it seems to me that the general plan of organization of these laboratories, providing as they do for special development in all proper directions of biological study, while retaining the conception of biology as one science, is eminently wise.

It would be a hopeless task for me to attempt to indicate to you all of the more important questions in which biologists at the present time are especially interested, even if I were myself familiar with them all. They penetrate into all provinces of life and relate to such matters as the complex organization of cells, the problems of heredity and development, the causes of variation in living organisms, the influence of physical and chemical agencies, and in general of environment, upon the behavior of living cells and organisms, the relations of micro-organisms to fermentation and disease, the finer architecture of the central nervous system, and countless other themes. An especially interesting and new direction of development, to which the biological department of this University has made important contributions, is the application of the experimental method to the solution of certain morphological problems. From this source we may reasonably expect valuable light to be thrown upon the great problems of development, variation and heredity, and thereby we may acquire a clearer and more accurate insight than we now possess into the factors concerned in organic evolution.

No branch of human knowledge exceeds in interest and importance the study of biology; none has made greater advances during this century of scientific progress; none is of more importance to human welfare; none has more deeply impressed modern philosophic thought. Biology has profoundly influenced man's attitude toward Nature and the views as to his own position in the scale of being. It has important bearings upon social and moral questions. With true religion it has no contest, whatever may have been its influence upon dogmatic theology. It reveals the marvellous fitness of organic nature, and it cultivates one of the finest human sentiments, the love of nature. Who but a biologist, who was also a poet, could have sung of the chambered nautilus?

"Year after year beheld the silent toil
That spread his lustrous coil;
Still, as the spiral grew,
He left the past year's dwelling for the new,
Stole with soft step its shining archway through,
Built up its idle door,
Stretched in his last-found home, and knew the old no more."

To those who seek the practical utility of scientific study biology can show its triumphs, but here as elsewhere in science the important discoveries which have found useful applications have been made by the devotees of pure science rather than by those who make technical utility their guiding principle.

No more striking illustration of the practical benefits conferred by biological discoveries can be given than that derived from the investigation of those lowly micro-organisms which are partly our friends, the preservers of the very existence of life upon this globe, and in smaller part our enemies, the causes of infectious diseases. It would be a long story should I attempt to rehearse the useful discoveries in this domain; how Pasteur saved the silkworm industries of France by his studies of a microscopic parasite; how agriculture and dairies and industries concerned with fermentative processes have been benefited; how preventive inoculations have saved the lives of thousands of animals; how surgery has been revolutionized by Lister's application of Pasteur's discoveries; how the scientific study of immunity has opened up new vistas in preventive and curative medicine, as exemplified by the antitoxic treatment of diphtheria and preventive inoculations for rabies, which have led to the saving of untold thousands of human lives. All of the money ever expended for the promotion of biological science has been repaid a thousand fold by the useful applications of biological discoveries, and in making this statement in this presence I trust that I shall not be thought for a moment to countenance that Philistine view of science which would estimate its value in money or in immediate practical utility.

I have already had occasion to touch upon another side of biology, which is not at present here provided for and which may not be so familiar to all as a biological science. I refer to pathology or the study of life in its abnormal forms and activities. This is the pure science of medicine as distinguished from the art of healing. It is just as truly a department of biology as is the study of normal life. The relations of pathology to practical medicine are so intimate that the broader conception of this science as a part of biology is not always appreciated. Nevertheless pathology may be cultivated as a science no more subordinated to practical ends than is any other natural science. Its subject matter is any living thing which deviates from the normal condition. Its province is to investigate abnormal structure, disordered function and the causes of these abnormalities. Pathological biology must rest upon a knowledge of normal biology. Between these two great divisions of biology no sharp lines of demarcation can be drawn. The province of one encroaches at many points upon that of the other and they are capable of yielding each other mutual aid.

Although certain directions of pathological study can be followed in a University independently of a medical school, the natural environment of a pathological laboratory is the medical school and hospital, where it can obtain the necessary material for study. Here only can pathology flourish in its entirety.

At the exercises connected with the laying of the corner stones of these laboratories, President Harper uttered these significant words: "In laying these corner stones to-day we are laying the foundations of a school of medicine, for aside from the distinct work outlined in each department there is that great and important service to be rendered in the establishment of a school of medicine, the chief work of which shall be investigation." It will not therefore be out of place at the dedication of these laboratories if I say a few words concerning their relations to the proposed school of medicine and the need of such a school.

A university is the historical and proper place for the establishment of a medical school. Before there was a school of law at Bologna or of theology at Paris, there was a school of medicine at Salernum. For centuries all that there was of biology was to be found in the medical faculty. The union between medical school and university is of mutual advantage and each receives renown from the other. The distinction of great universities has often rested in no small measure upon their medical faculties, as witness such names as Johannes Müller, Virchow, DuBois-Reymond, Ludwig, Kölliker, to mention only a few biologists. The advantages to the medical school of this union are manifold. Among the more important of these may be mentioned the encouragement of research, the development of the scientific spirit and of university ideals, the proper maintenance of laboratories, contact with other departments of science, economy of organization, and improved methods of instruction. To secure these advantages the union must be a real one. There is no saving grace in merely calling a medical school a department of a university. The medical school must be a vital, integral, co-ordinate part of the university. It should also be said in this connection that the granting of the doctor's degree is the function of a university and it is a usurpation for it to be assumed by independent medical schools responsible to nobody.

Medical science and art rest upon a knowledge of anatomy and physiology and these latter subjects are included in the special medical studies. But before undertaking these special studies it is in every way desirable that the students should have had a liberal education which includes a fair training in physics, chemistry and general biology with the ability to read French and German. You not only have here all that is requisite for the training preliminary to medical education, but you have in these biological laboratories the foundation of a medical school and a part of the superstructure. The usefulness of these laboratories, great as it is under existing conditions, would in my judgment be still further enhanced, especially in certain departments, by association with a medical school, and I need not emphasize the enormous value which the medical school would derive from them.

Not only this University but also the city of Chicago by its size and situation offers peculiarly favorable conditions for the foundation of a great medical school such as is here contemplated.

The present state of the science and art of medicine and of medical education renders especially urgent the claims of higher medical education. Medical science has made enormous strides during the last two decades. The present is a period of great and fruitful activity in medicine. New points of view have presented themselves. Problems of the highest importance to science and to humanity are awaiting only suitable opportunity and patient investigation for their solution. Methods of the laboratory are now applied to the practical study of disease for purposes of diagnosis, prognosis and treatment. The practice of the healing art is a far more scientific and rewarding pursuit now than formerly. The great discoveries relating to the agency of micro-organisms in the causation of disease have given a firm basis to preventive medicine, which has as yet been able to utilize only a relatively small part of the available knowledge.

To the new conditions medical education has as yet only imperfectly adjusted itself. The great need of our medical schools is the establishment of thoroughly equipped and well organized laboratories and these require endowments which none in this country possess to any adequate extent and few possess at all.

While the primary aim of a medical school is to train practitioners of medicine and surgery, a great medical school should also advance the science and art of medicine. This art is becoming in increasing degree applied science, and it cannot be fully acquired without training in the biological medical sciences. I think that in a four years medical course, the first two years should be devoted to the study of the fundamental medical sciences, such as human anatomy, physiology, physiological chemistry, pharmacology, and pathology, and the last two to strictly professional training in practical medicine, surgery and obstetrics. It is one of the most important problems of medical education to maintain the proper balance between the purely technical training in the medical art and the study of the medical sciences. The cultivators of pure science in this or any other university need have no fear that the introduction of a medical department, organized in accordance with the present state of medical science, and to meet the existing needs of medical education, will bring any elements unsuited to the highest university ideals.

A suitably endowed medical school united with a university has to-day in this country unequaled opportunities to achieve success, and to confer a great service upon medicine and upon humanity. The need of such schools is everywhere recognized by the medical profession which would give to their establishment enthusiastic support.

For this purpose you will need large endowments. You will require a hospital with dispensary service. This need not be a very large hospital, but it should be entirely under your control. You will require additional laboratories of pathology, hygiene, pharmacology, and physiological chemistry. The teachers selected should be also investigators and those engaged in the scientific departments should be well paid, so that they can give their whole time to their subjects.

Medical education has not been a favorite object of endowment. Its needs are very imperfectly understood by the community, and our medical schools in the past have for the most part not been such as to encourage their support by private beneficence. But these conditions are changing as witness the names of such benefactors of medical education as Johns Hopkins, Vanderbilt and Mary Garrett.

Every one who has a patriotic pride in seeing this country take its proper place in the great movement forward in medical science and education, would rejoice to see here in connection with this University and in Chicago, such a medical school as I have endeavored to indicate. In no other direction could this University expand with greater promise of usefulness and renown, than in the promotion of the highest medical education. With the unbounded energy and will of this University and of this city, never content with what has been accomplished, however wonderful, but building for the future, it is not too much to say that you could attain something greater and better than has been hitherto achieved.

In conclusion, I desire to express the hope, indeed the conviction, that the Hull Biological Laboratories, which are now open for active work, will fulfil their high promise, will be guided by wisdom, will cherish high ideals, will contribute abundantly to knowledge, will be a centre to which students will wander from far and near, will be a fortress of sound biological thought and education.

HAIR AND FEATHERS.

By J. S. Kingsley.

Birds and mammals, the highest groups of the whole animal kingdom, are sharply marked off from each other and from all other vertebrates by their tegumentary structures, feathers in the one group, hair in the other. Naturally structures so characteristic and evident as these have been made the subject of numerous investigations, but the more recent and more thorough studies have been published almost exclusively in German, and hence a summary of these may be acceptable to American readers. In the preparation of the following account the recent able review by Professor Keibel[1] has been freely used.

In the skin of the higher vertebrates two distinct portions may be recognized, differing in origin, structure, etc. The outer of these layers, the epidermis, arises from the ectodermal layer of the embryo, while the other layer, the cutis or dermis, has its origin in the mesoderm (mesenchyme). When fully developed the epidermis consists of a basal layer of cells resting on the dermis and receiving nourishment from it. By continual growth and consequent division, this basal layer produces other cells which come to lie outside it, but these more superficial portions, removed from any food supply, do not grow or divide, but die, dry up and become hardened into a horny cuticular layer which gradually wears away and is as constantly renewed from beneath. Outside of this cuticular layer comes a third layer, the epitrichium, only a single cell in thickness, which is lost in the mammals at a very early date, but which persists until a later stage in birds.

The deeper layer of the skin, the dermis or cutis, is largely composed of dense fibrous connective tissue, the fibres of which are tightly interlaced, and among them run nerves and minute blood vessels, while here and there are developed muscle fibres of the smooth or involuntary type. This dermis is separated from the deeper tissues by a loose or aveolar connective tissue, in which fat is often developed to a considerable extent.

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[1] Merkel und Bonnet's Ergebnisse der Anatomie und Entwickelungsgeschichte, 1896.

In the development of a hair slight differences are observable in different forms. In some the first phenomenon is the appearance of small papillæ in the dermis at the points at which hair is subsequently to be formed; in others the process of hair formation is initiated by changes in the epidermis, which only appear after the formation of the papillæ in the first mentioned types. This change consists in an elongation of the basal cells in a direction at right angles to the surface where the hair is to appear (fig. 1), the result being that the epidermis becomes slightly pushed into the dermis in these areas. Beneath these thickenings, there next follows a multiplication of dermal cells. As growth continues the inpushings increase in extent, while the dermal cells arrange themselves around the ingrowth to form a hair follicle with a slight projection, the hair papilla, at its base (fig. 2), the latter being supplied by a small capillary loop.

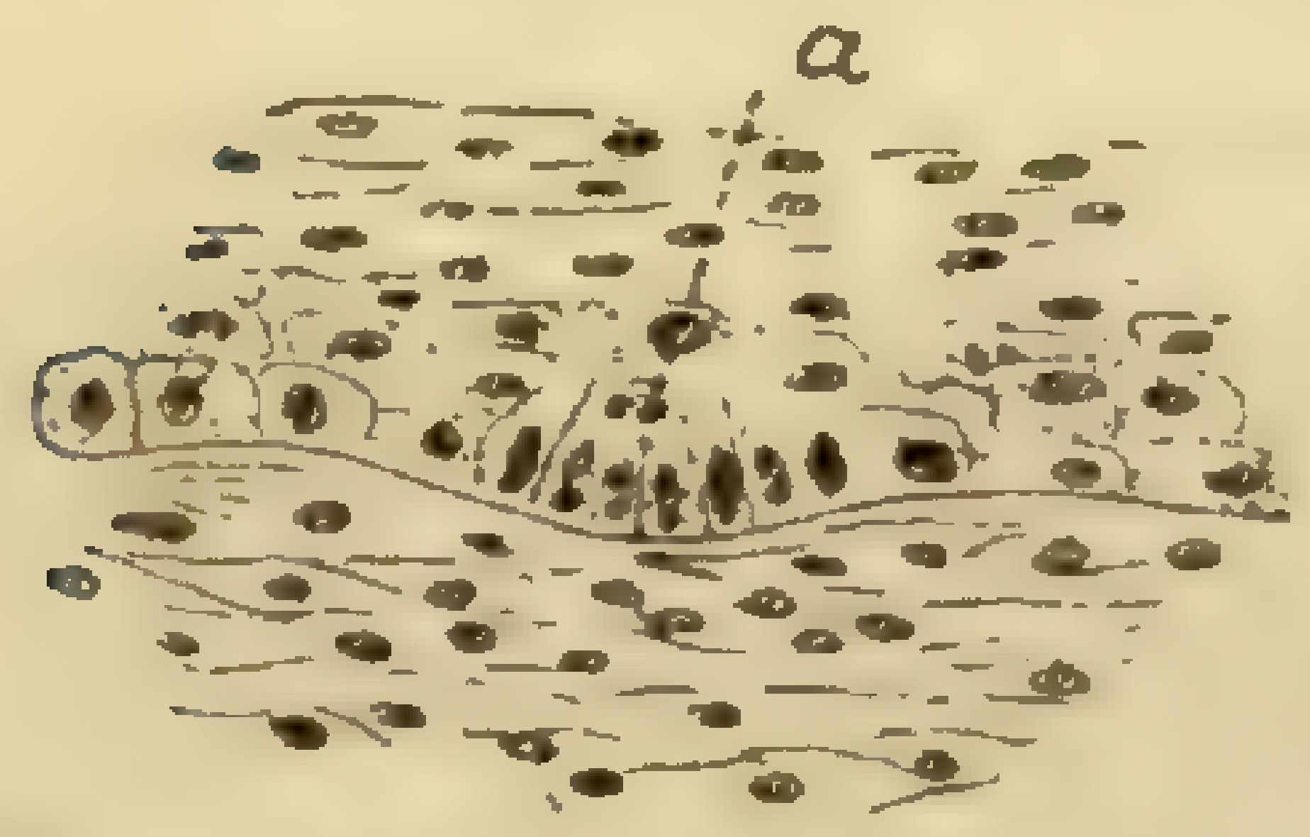

FIG. 1.—Section through the earliest stage of hair formation in a mouse, after Maurer. At *a* is shown the change in the basal layer of the epidermis.

So far the epidermal ingrowth has been solid, but now a circular depression appears, which, deepening with time, separates a central portion, the rudimentary hair, from a surrounding sheath (fig. 3). The relations will readily be seen from the illustrations, but a few words may be added to make all clear.

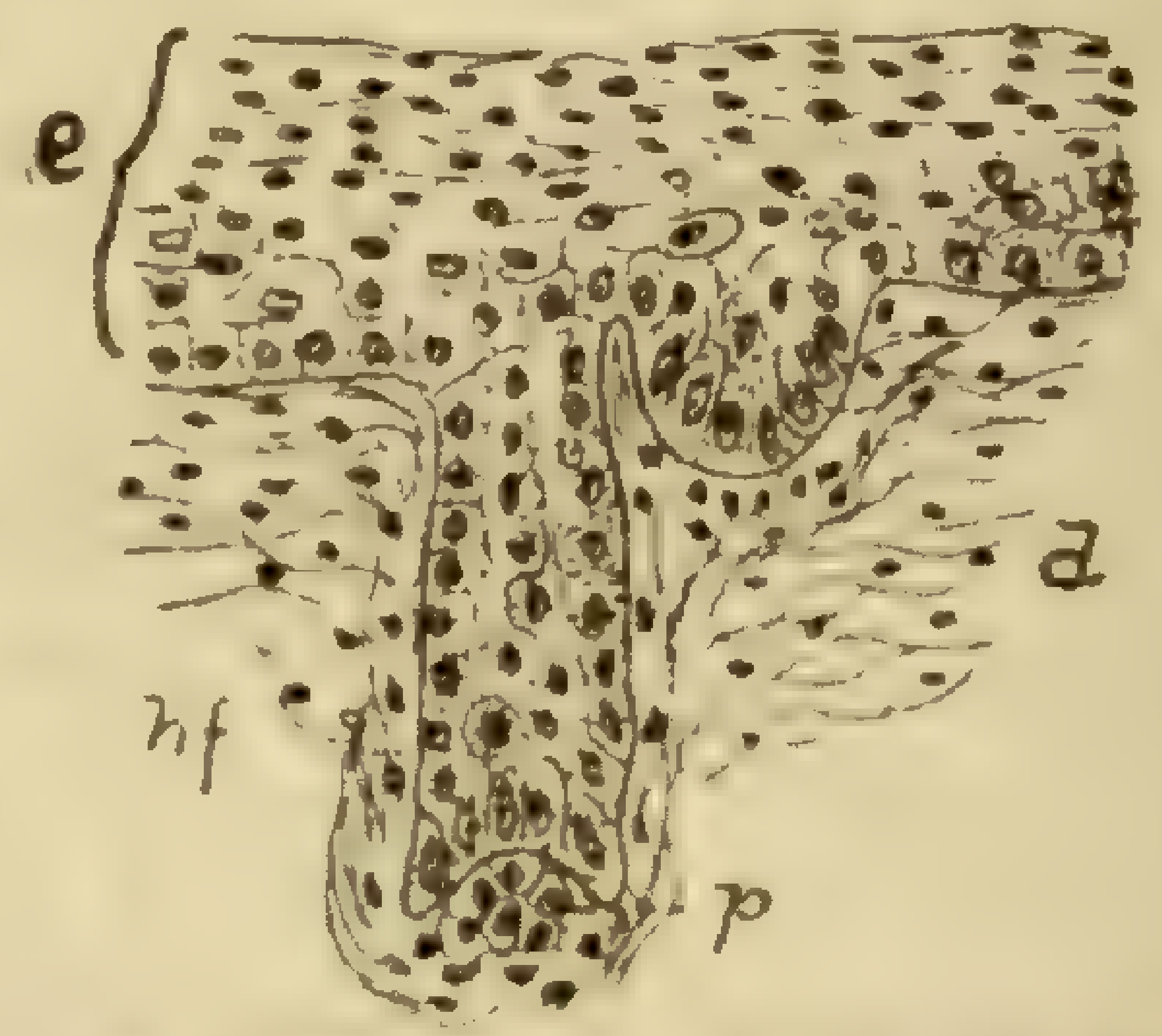

FIG. 2.—Later stages in the development of the hair in the mouse, after Maurer. On the right an earlier stage; on the left a later stage: *e*, epidermis; *d*, dermis; *hf*, hair follicle; *p* papilla.

In figure 3 the hair is shown as a solid structure made up, as it protrudes from the skin, of three concentric layers; a central medulla, a middle so-called cortical layer, and an outer cuticular layer. Inside the follicle two other layers are seen, known by the names of those who first described them, the outer as Henle's layer, the inner as Huxley's layer. At one side of the follicle is shown the gland which secretes the oil, and which is clearly a derivation of the epidermis, while in several places are medullated nerve fibres connected with the sheath of the hair. The growing point of the hair is at the base of the follicle where the deeper epidermal cells, by constant division, produce other cells, which are added to the base of the hair, thus causing it continually to increase in length.

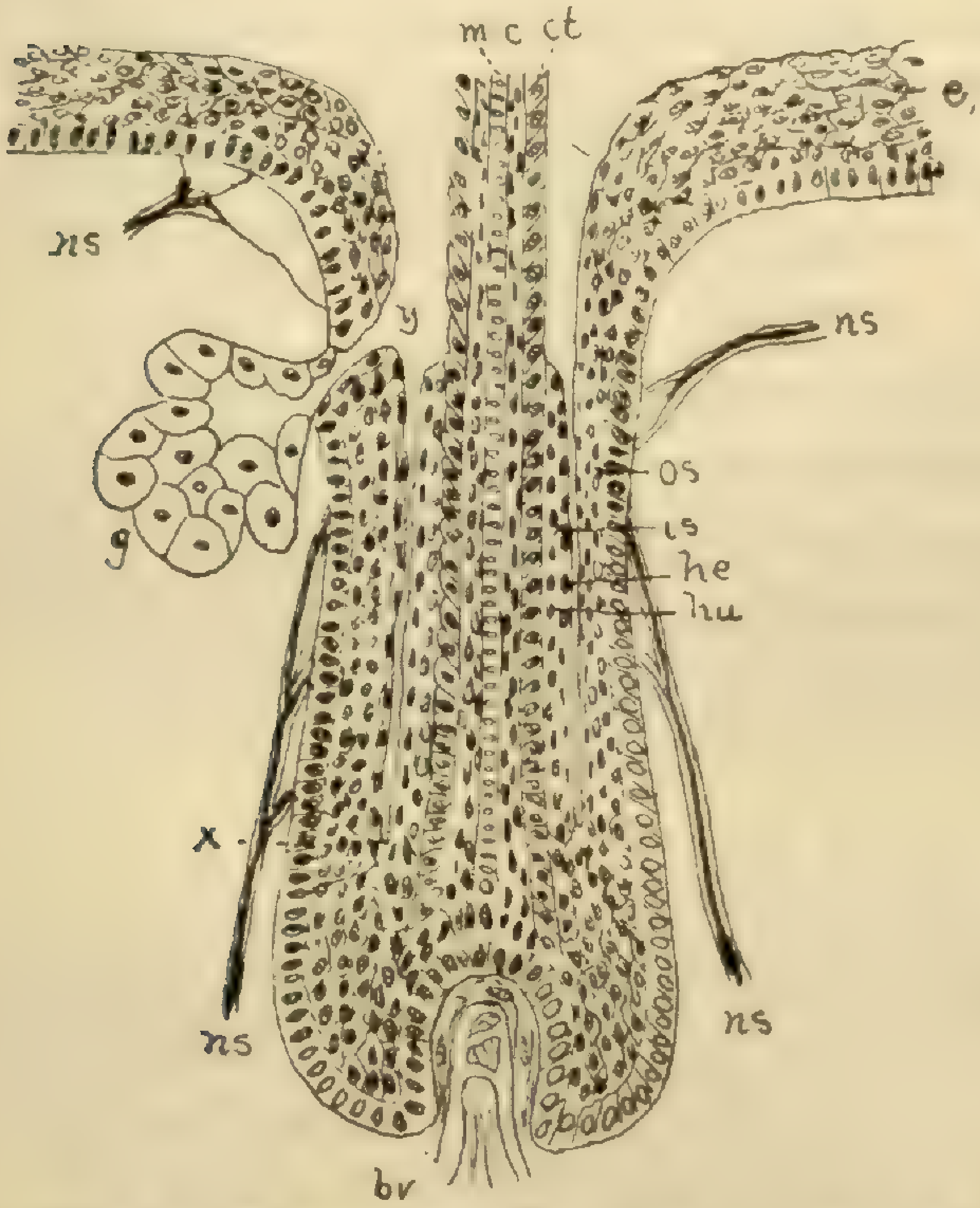

FIG. 3.—Diagrammatic section of hair and hair follicle, after Maurer. *bv*, blood vessel; *c*, cortical layer of hair; *ct*, cuticular layer; *e*, epidermis; *g*, sebaceous gland; *he*, Henle's layer; *hu*, Huxley's layer; these two composing *is*, the inner root-sheath; *m*, medulla; *ns*, secondary nerves; *os*, outer root-sheath; *x* and *y*, points regarded by Maurer as homologous with *x* and *y* of figure 13 with which this should be compared.

It may be well to say parenthetically that hair is not hollow; that the natural oil does not flow through it as through a tube, and that the singeing so strongly recommended by barbers will not close up any "openings through which the vital fluids of the hair escape."

When we look at any hairy surface the hairs appear to be arranged without any order. It is, however, interesting to note, in the light of what is to follow, that Maurer claims that the first hairs to be formed—at least in certain mammals—are arranged in a few rows, and that these rows have a definite position (fig. 4). With the later increase in the number of the hairs this regularity is lost, an intermediate stage showing the hairs arranged in groups, but it is not yet settled exactly how much of the increase in number is to be explained by the division of hair follicles and how much by new formation. So, too, in the replacement of molted hairs it is doubtful whether a new papilla is formed, or whether the old papilla retains its functions.

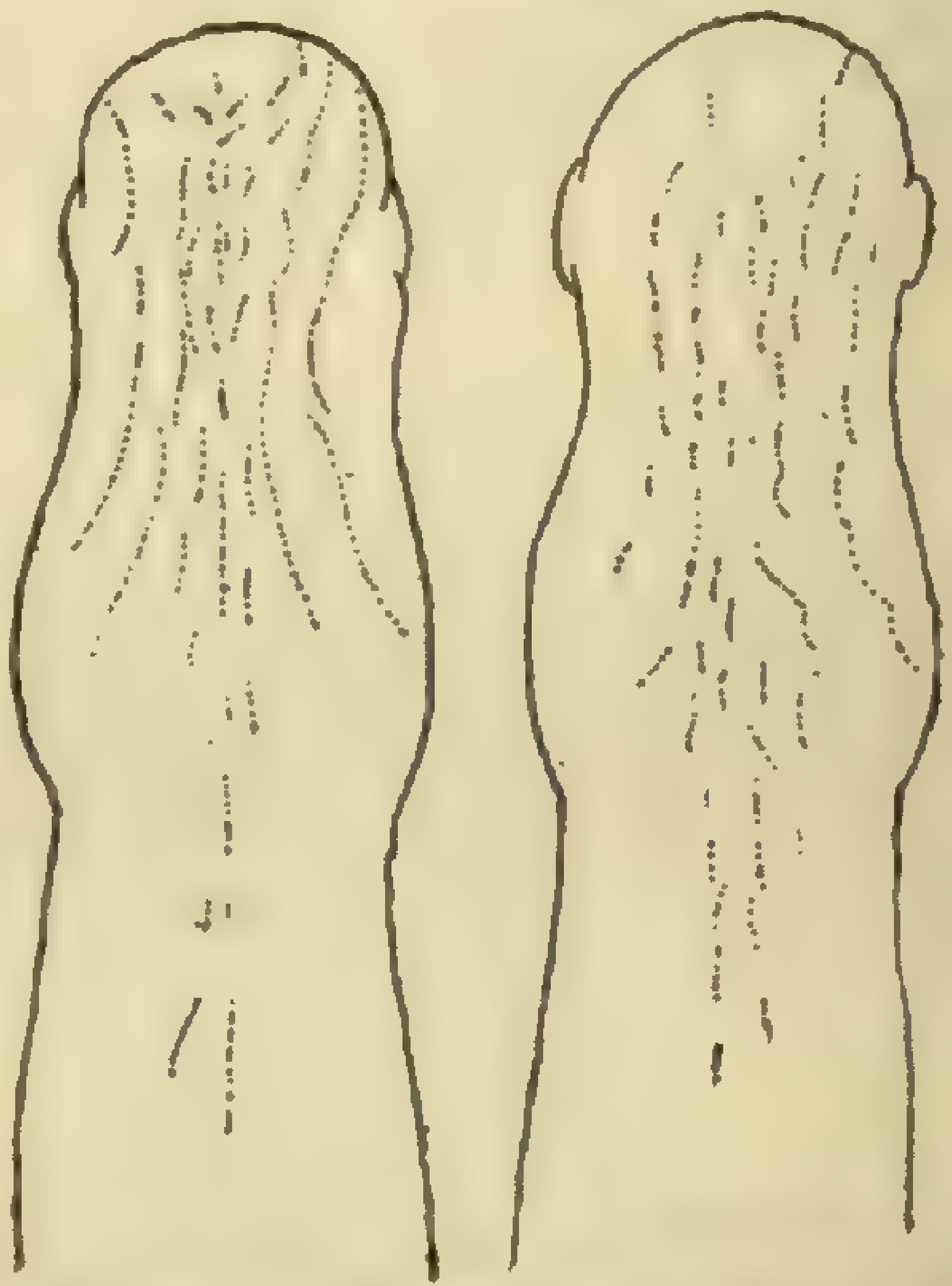

FIG. 4.—Two dorsal views of an embryo cat showing the early hair tracts. In the right hand figure the rows have been broken into patches. After Maurer.

When we analyze the phenomena of hair formation we find that the epidermis takes the initiative so far as cell multiplication is concerned. With feathers, on the other hand, the increase in cells begins in the dermis, the result being a slight elevation of the surface of the skin. Next the deeper cells of the epidermis form themselves into a double layer (fig. 5) and the whole is strikingly suggestive of a scale, in that one edge of the elevation projects more than the other. This outgrowth increases in extent until there results a cylindrical process protruding from the skin (fig. 6) with a very slight insinking, the rudiments of the future feather follicle, at its base. In this outgrowth, which is to give rise to the future down-feather, both dermis and epidermis may be recognized.

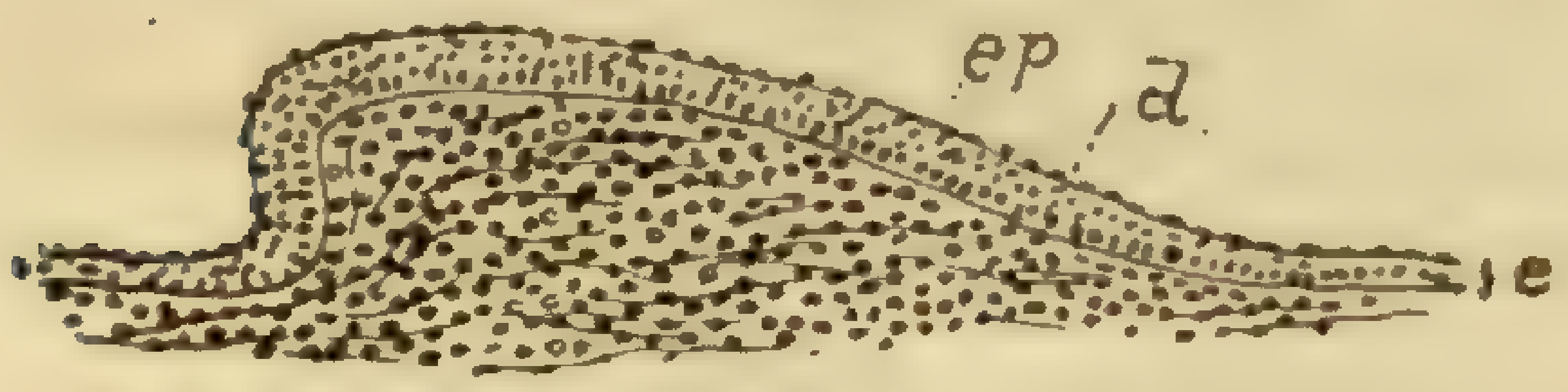

FIG. 5.—Early stage in the development of a down feathers in the pigeon. After Davies. *E*, epidermis; *ep*, epitrichium; *d*, dermis.

The epidermis has increased in thickness by cell multiplication, while the epitrichium retains its primitive condition.

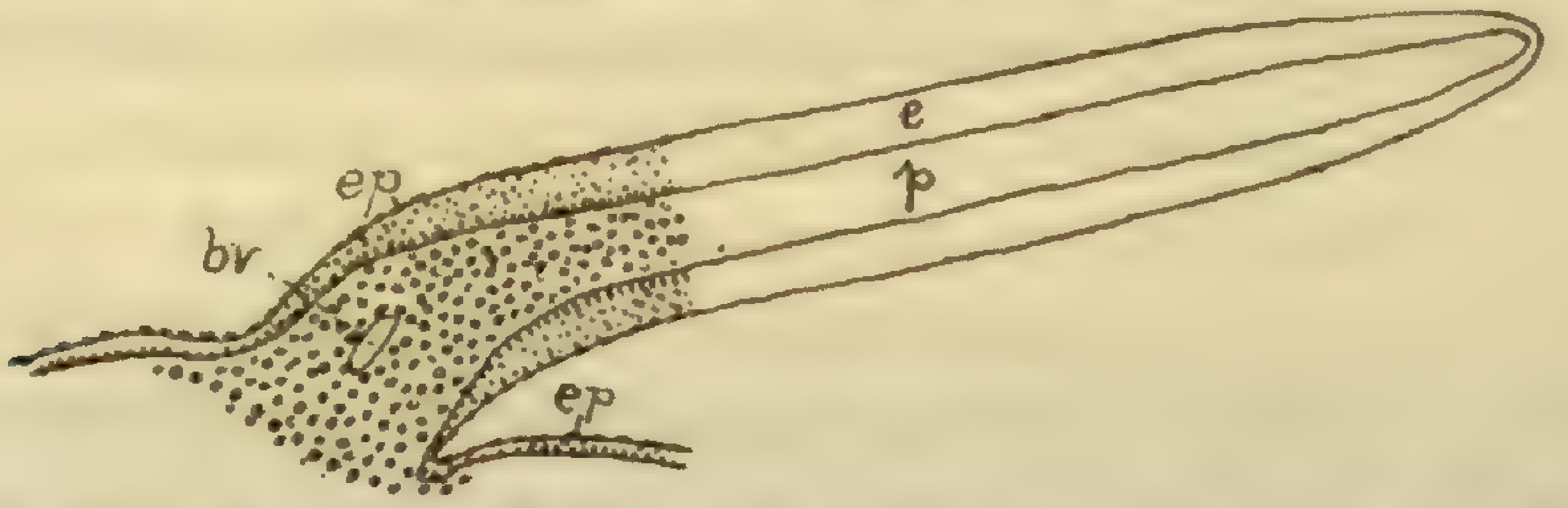

FIG. 6.—Longitudinal section of a later stage of the down feather, after Davies, *bv*, blood vessel; *e*, epidermis; *ep*, epitrichium; *p*, pulp of the papilla. The basal layer of the epidermal cells have assumed a cylindrical character.

The dermal portion, hereafter to be known as the pulp, has undergone modifications best understood by reference to a transverse section (fig. 7). It no longer has a smooth contour, but is produced in a radial manner into longitudinal ridges which nearly reach to the epitrichium. As a result of this the epidermal portion becomes divided into a corresponding number of rod-like structures, each of which becomes surrounded by a structureless ensheathing envelope produced by the basal layer of the epidermal cells.

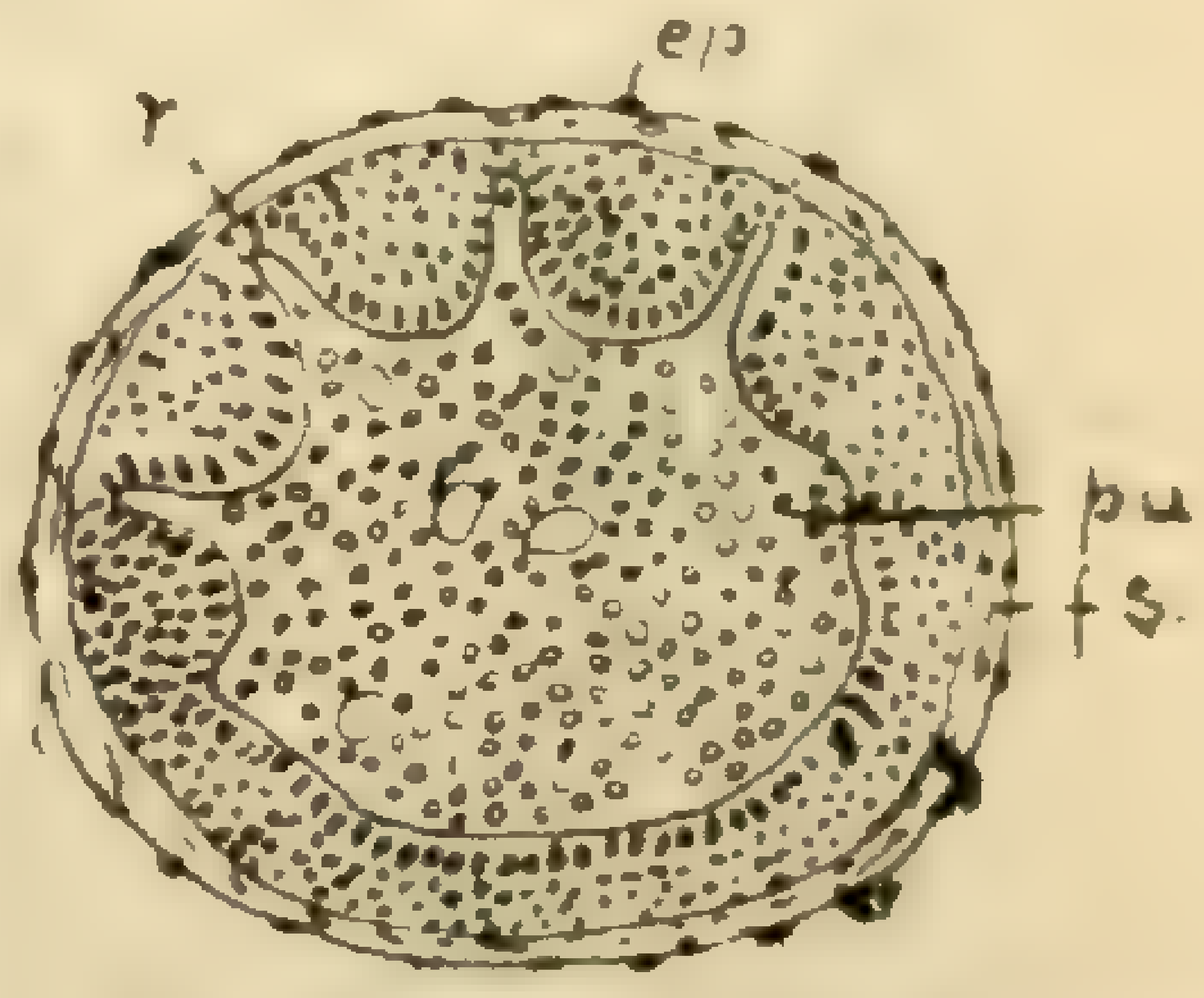

FIG. 7.—Slightly oblique section of a young down feather of a chicken near the base. After Davies. *ep*, epitrichium; *fs*, feather sheath; *pu*, pulp; *r*, ridges of the pulp dividing the epidermis into a series of rod-like structures.

The pulp now begins to retract towards the surface of the skin, leaving the whole outgrowth hollow, except for structureless partitions—the pith of the quill—here and there, produced by the retracting epidermis. The parts remaining external to surface of the body gradually dry up and become cornified, and, the epitrichial sheath breaking away, the epidermal rods just mentioned separate at their free ends, so that the well-known down-feather results, the basal, undivided portion of the outgrowth forming the small quill.

During this formation of the down-feather the follicle becomes much deeper, so that at length it presents considerable superficial resemblance to the hair follicle, and into it the dermal pulp retracts after the full formation of the down-feather is complete.

According to Davies all contour feathers are preceded by down-feathers, and even those cases which seem to form exceptions to this statement are found upon more accurate observation to accord with it. The statement may be put in another way: the germ of the definitive feather is a direct derivative of the germ of the down-feather. Let us now follow the development of a symmetrical contour feather.

With the retraction of the pulp (fig. 8) the follicle widens while the feather papilla enlarges so as to contain a much more considerable pulp, but in other respects it is closely similar to the earlier down papilla except that it is seated in a follicle. There now occurs the same outgrowth of ridges from the pulp as before, dividing the epidermis in a similar manner, with the following exceptions: In the down papilla these ridges were parallel to the axis of the future feather; in the contour feather (fig. 9) they are oblique to that axis, the result necessarily being that the formations of a series of long slender processes—the future barbs—which are connected with an undivided portion, the shaft—on the so-called dorsal side of the papilla. Around all is developed a sheath as before.

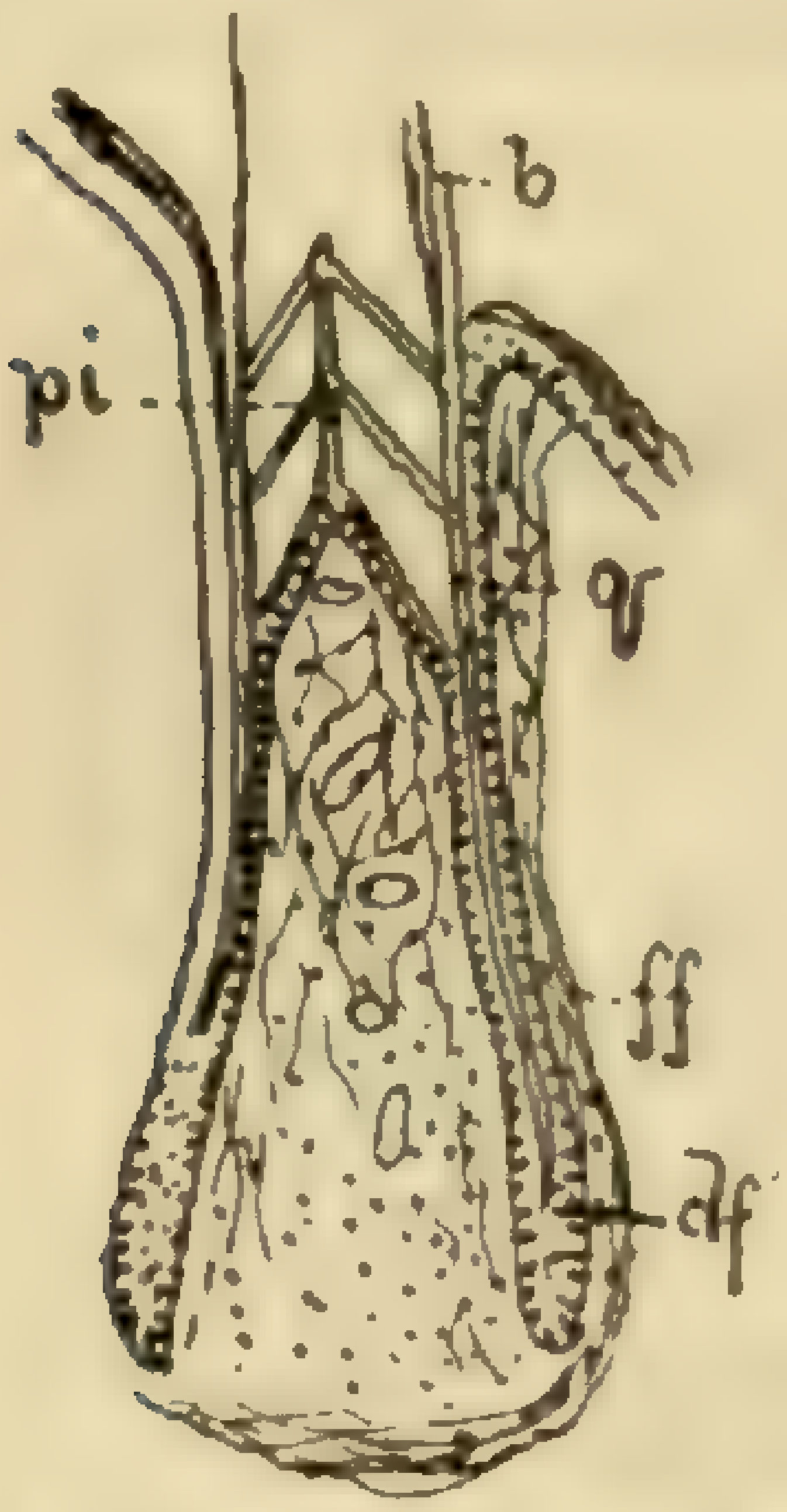

Fig. 8.—Longitudinal section through the shaft of a primary down-feather, after Davies. *b*, barbs; *df*, apex of the definitive feather germ; *ff*, feather follicle; *pi*, pith; *q*, quill.

This dorsal or shaft region demands a little closer attention. As seen in transverse section (fig. 10) the shaft shows on its inner edges longitudinal thickenings which, increasing in size, meet each other in differing ways in the different parts of the feather. A glance at figure 11 will explain this better than pages of description. The four sections are made at different levels, *A* being near the tip and *D* through the quill below the vane. Around each is the feather sheath and inside of each is the pulp cavity. In *A* the ingrowing edges of the shaft meet each other, and form a solid rod. Farther down, as in *B* and *C*, they include in the ingrowth a portion

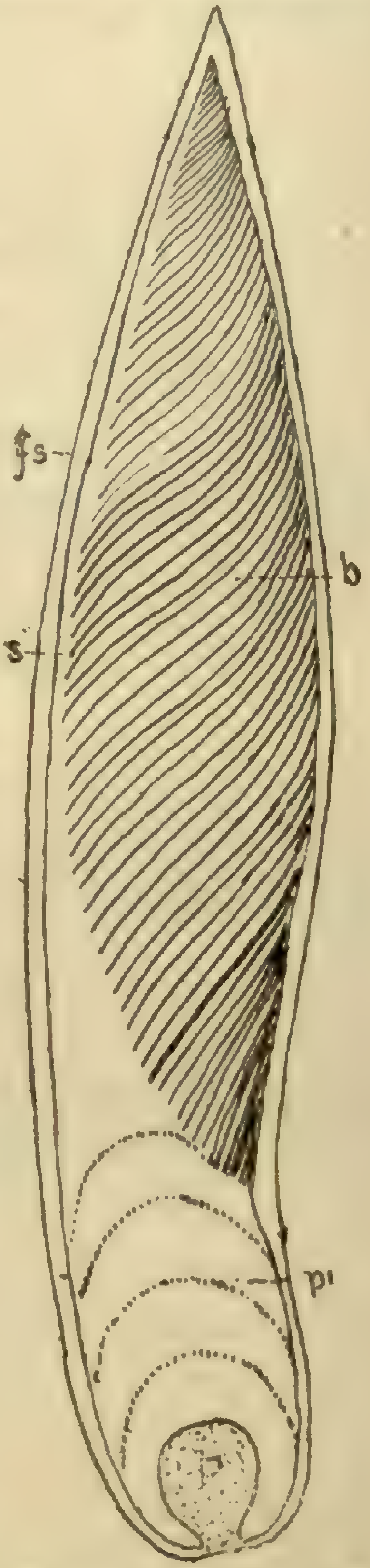

Fig. 9. — Diagrammatic representation of a definitive feather in its sheath, represented as a transparent object, after Keibel. *b*, barbs; *fs*, feather sheath; *p*, papilla; *pi*, pith; *s*, shaft.

of the pulp cavity thus making this portion of the shaft hollow; while in *D*, taken below the vane we have no barbs and only the hollow quill.

With the contour feather, as with the down feather there is the same retraction of the pulp and the same formation of pith as has already been described. After the feather is complete the retracted pulp remains quiet until about the time of the molt when it comes to the front again to form the new feather. The feather, the development of which we have been following, is as yet cyclindrical in shape and is still enclosed in the feather sheath. With the retraction of the pulp it dries and becomes horny as before, the sheath breaks away and the barbs by their elasticity straighten out and become arranged on either side of the shaft (see fig. 12) so as to form the well-known vane.

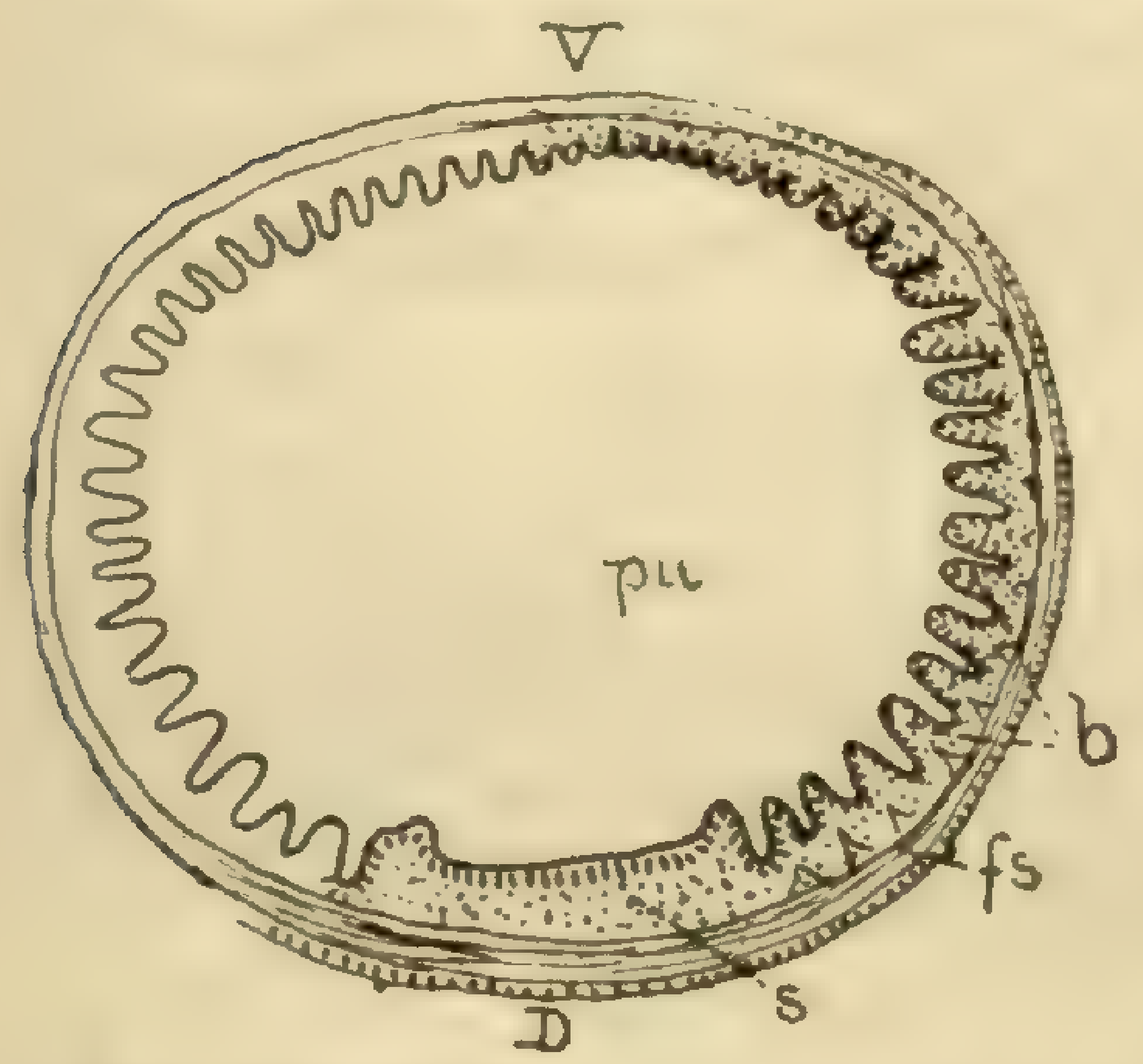

Fig. 10.—Section near the tip of a developing contour feather of a Canary, after Davies. *b*, developing barbs; *fs*, feather sheath; *pu*, pulp; *s*, sheath; *d* and *v*. dorsal and ventral.

There are here to be mentioned two points. The first is that the upper and lower surfaces of the contour feather do not correspond to the upper and lower surfaces of the papilla but rather to the inner and outer surfaces of the feather-forming epidermis, as may be seen by a comparison between figures 10 and 12. The other matter is this: With the withdrawal of the pulp from the feather there is no longer any nerve or blood

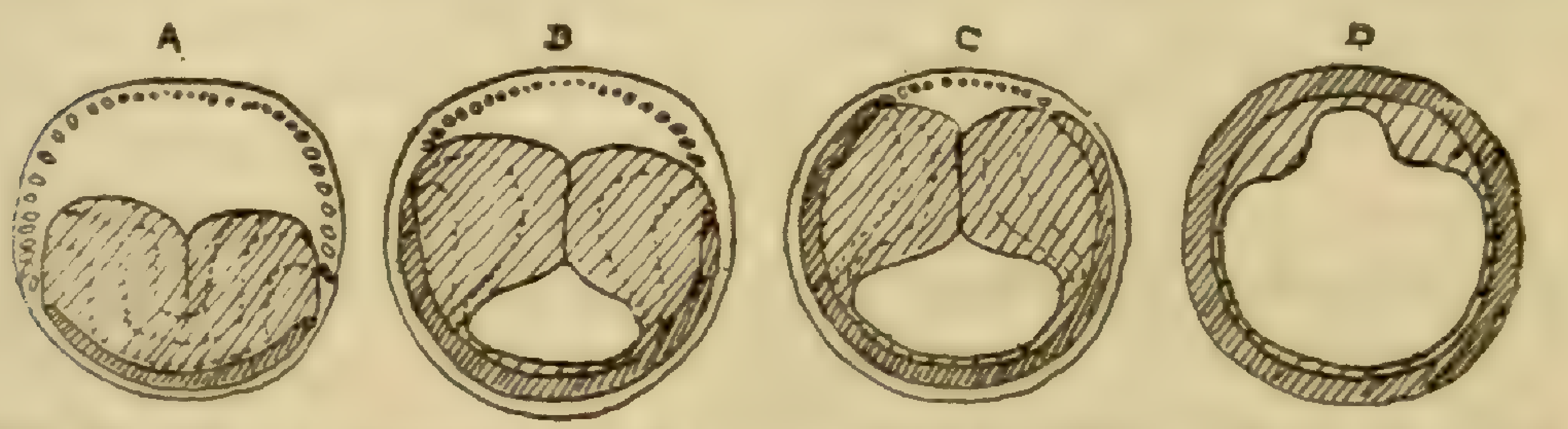

Fig. 11.—Four transverse sections through fig. 9 at different levels, *A*, near the tip; *D*, near the base.

supply to the parts of the feather. The cells of which it is composed are dead and dry so that it seems impossible that any change can take place in it. The whole question of change in color of the fully formed feather was recently reopened by Mr. J. A. Allen who maintained that, once formed, the feathers do not change in their markings. The whole history of development seems to afford him full support. Yet this year the attempt has been made to show that feathers do change in their markings. In this, as the matter now stands, the burden of proof is upon those who support the possibility of change.

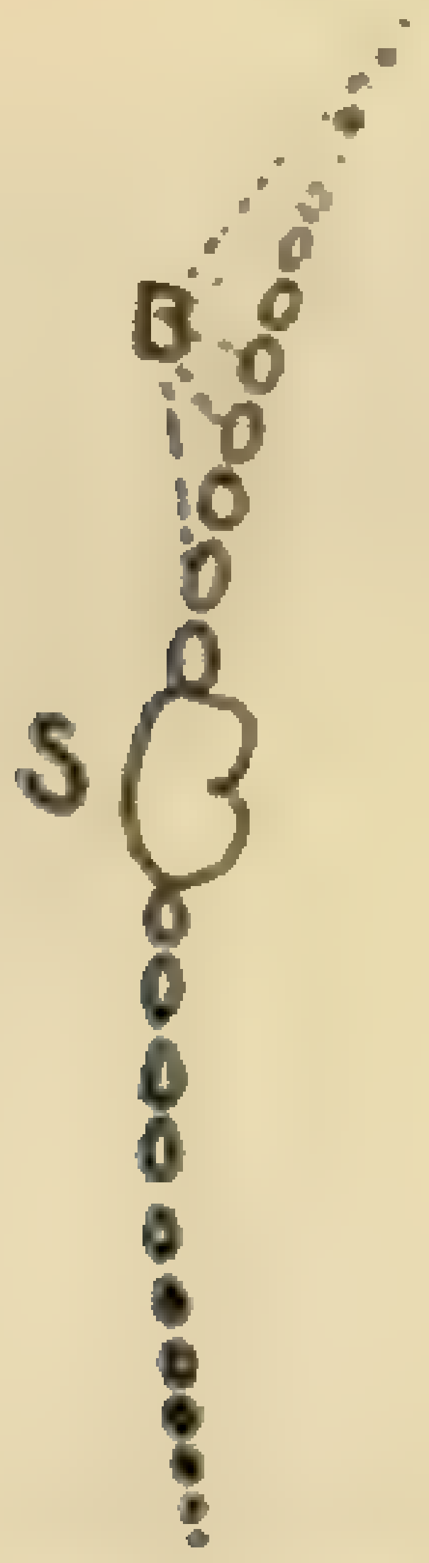

Fig. 12.—A section through a feather at the level of fig. 11A, after the rupture of the feather sheath and the spreading out of the barbs (*b*) to form the vane; *s*, shaft.

Another aspect of the hair and feather question must now be taken up. How did these two structures come into existence? They certainly were not formed *de novo*, for it is one of the axioms—we had almost said—that all structures are to be traced back as modifications of pre-existing structures. If this be so, to what can these structures be referred?

Until very recently the attempt was made to show that hairs and feathers were homologous in origin. Thus the older students sought to find intermediate stages in the pin feathers, which are certainly hair-like in appearance; and to derive both hair and feathers from the Reptilian scale, a view which received much seeming support from the tarso-metatarsal scales of birds and from the scale-like feathers of the penguins, as well as from the scaly armor of pangolins, etc., on the mammalian side. The interested student will find all of these views ably and concisely summarized by Keibel; our space will not admit more than this reference to them. It may be said, however, that Davies, to whom we owe the most accurate account of the development of the feather declines to regard pin feathers as the simplest type of the avian tegumentary covering but rather as a retrograde condition; and farther, that he regards the scales upon the tarsal and digital regions of birds as secondary formations, agreeing in this with Jeffries.

If the Mammals be, like the birds, descended from the Reptiles then it is natural that we should look for those structures which have given rise to hairs in connection with the Reptilian integument. On the other hand there are those who believe that the Mammals spring direct from some Amphibian stock and to these the recent work of Maurer is full of interest. Maurer maintains that hair and feathers are not homologous structures. The feather, according to his view has been derived from the Reptilian scale while hair has arisen from the dermal sense organs of the Ichthyopsida as a result of a change in habits and conditions of life. As illustrating his views we have copied (fig. 13) one of his figures, a diagrammatic longiudinal section of at dermal sense organ of Triton after the metamorphosis, which should be compared with the diagram of the structure of the hair follicle and hair already given (fig. 3) the letters in each indicating the homologies recognized by Maurer.

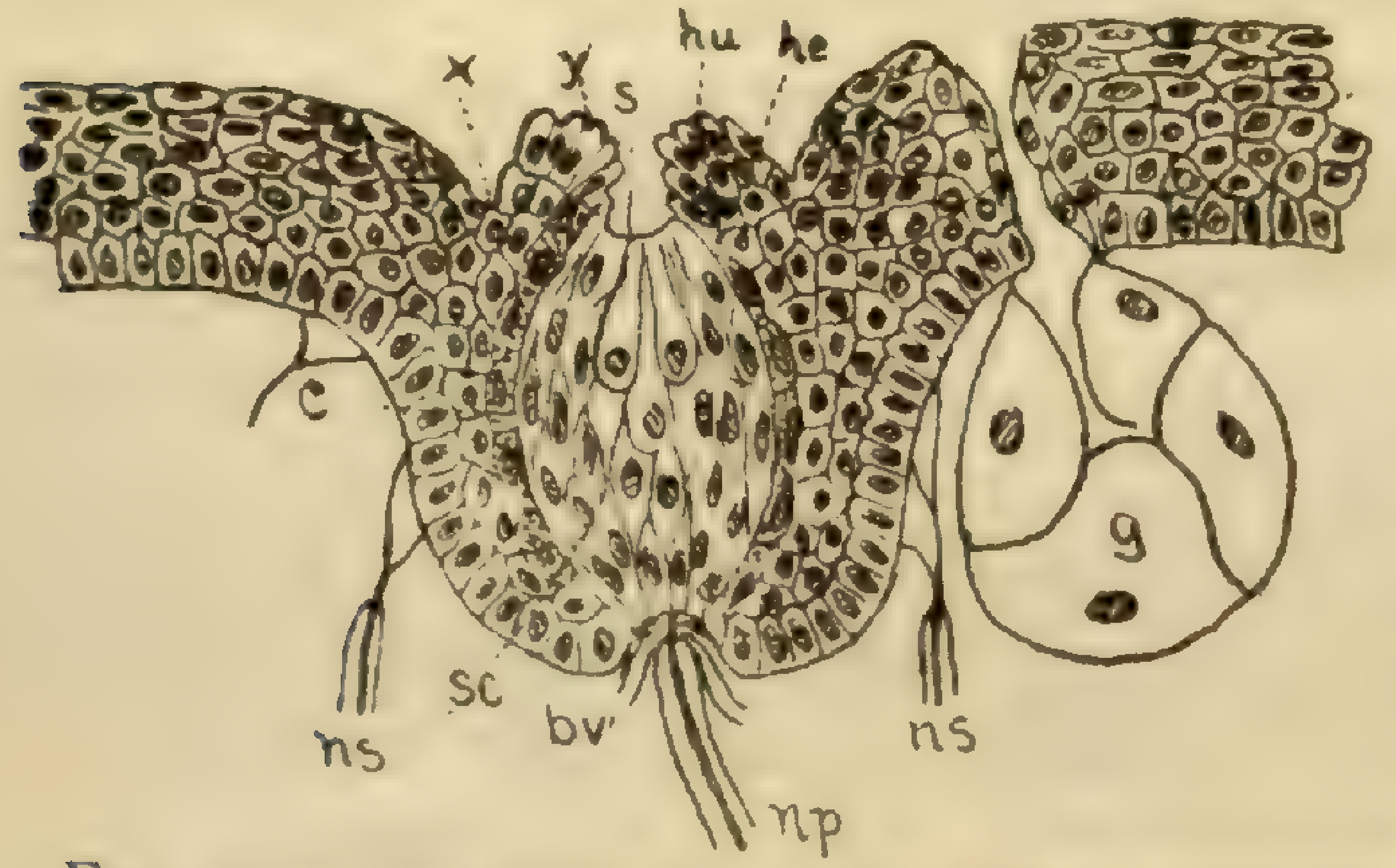

FIG. 13.—Diagrammatic section of a cutaneous sense organ of *Triton cistatus* after the metamorphosis; to be compared with fig 3. After Maurer. *bv.* blood vessel; *c*, cortical layer; *g*, gland; *he*, Henle's layer; *hu*, Huxley's layer; *np*, primary nerve; *ns*, secondary nerves; *s*, sense cells; *sc*, supporting cells, *x* and *y*, points regarded as homologous with *x* and *y* in fig. 3.

Slightly condensing his account, Maurer says, that when an Amphibian, like Triton after the metamorphosis, takes to the land, the supporting cells of the sense organs undergo a process of cornification and in this condition they show in the simplest form all of the parts of the hair and the hair follicle. With the transfer to land, as is well known, the dermal sense organs lose their original function, itself dependent upon the presence of water as a surrounding median. In the axis of the hair lies the medulla, consisting of dry incompletely cornified cells. In these I recognize the modified remains of the sense cells.[2] The cortical layer is derived from the horny supporting cells and the cuticula from the enveloping cells of the dermal sense organs. In the epithelium around the sense bud both Henle's and Huxley's layers may be seen forming the inner root sheath as in the hair; while the connective tissue envelope forms a sense bud follicle just as the same layer forms the hair follicle. Even a papilla is frequently present in many Amphibia; (e. g., Cryptobranchus), containing a capillary network; but since the hair has lost its sensory function the axial nerve of the sense organ has degenerated.

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[2] A view considerably different from those earlier advanced by him.

We cannot go into the wealth of fact and comparison which Maurer has advanced in support of his position (which we may say in passing, has won the acceptance of Gegenbaur) but some of his statements and conclusions should be summarized here.

According to Maurer two types of organs are developed from the integument. The epidermoid organs are those structures which both phylogenetically and ontogenetically arise exclusively from the epidermis, and to which the dermis only enters when necessity for protection or nourishment arises. Here belong the tegumentary sense organs of the lower vertebrates as well as the "pearl organs" of the Teleosts, the femoral pores of the lizards, dermal glands and lastly the hairs of the Mammalia. Integumental organs in the narrower sense are those which have their first foundation in an alteration of the corium and always arise as an elevation of that layer, although the epidermis may be associated with it later and may secondarily acquire great prominence. Here belong the scales of fishes and reptiles, the feathers of birds and certain mammalian scales.

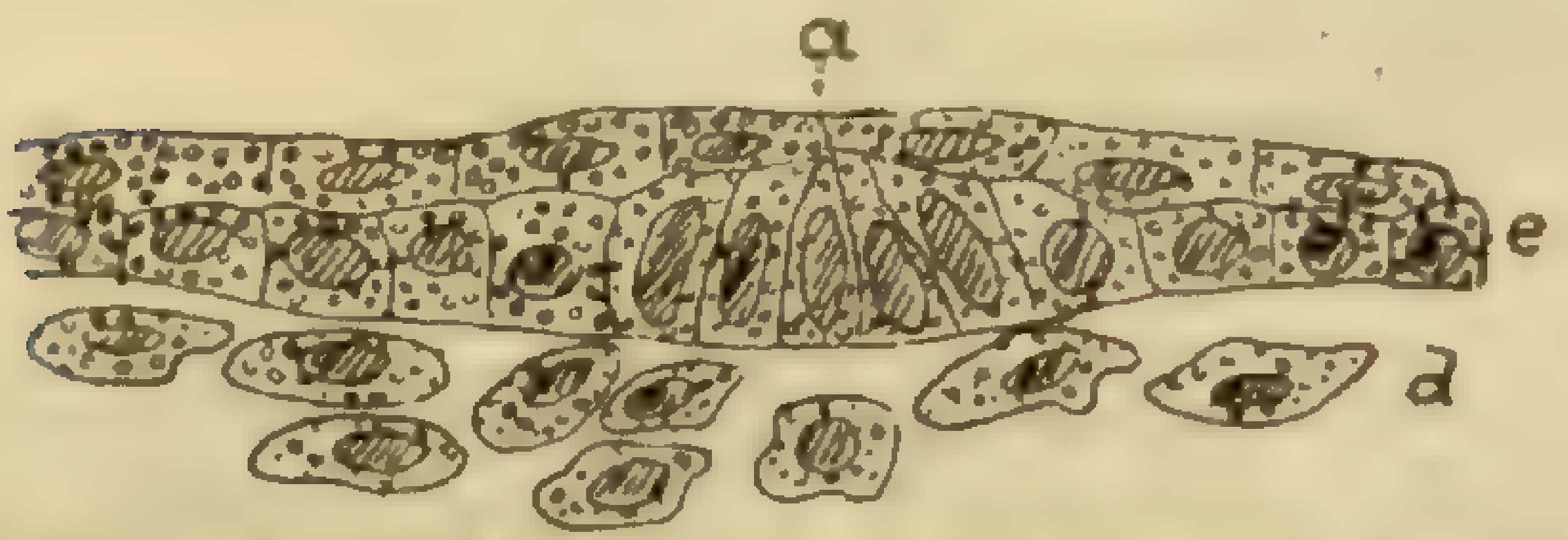

FIG. 14.—Section through the earliest stage of a developing sense organ of *Triton tæniatus*, after Maurer. At *a* the basal layer of the epidermis is changing in character, its cells becoming columnar, the first stage in their conversion into sense cells. Comparison should be made with fig. 1.

From this statement it is clear, if ontogeny be a test, that hair and feathers, are totally different structures; for as we have seen the development of hair begins with the epidermis; that of feathers as clearly with the dermis.

In the first appearance of the hair Maurer sees additional evidence in favor of his view. We have already alluded to the rows in which the earliest hairs are arranged. Maurer finds that the first tactile hairs to appear are arranged in the following rows: (1) supraorbital; (2) infraorbital; (3) zygomatic; (4) angular; (5) upper lip; (6) under lip; and (7) submental; and that these rows follow in a striking way, the course of the tegumentary branches of the tregeminal nerve. The other hairs are not irregularly arranged but are also in regular rows (see fig. 4) and, thinks Maurer, these rows are closely connected with the rows of sensory organs in the Amphibian skin. The grouped arrangement of hairs is secondary and the point of origin of a group is a single hair the follicle of which by budding gives rise to other follicles and hence to the hair group. Such a means of increase is found no where else than in the sensory organs of the Ichthyopsida.

It would be interesting did space permit to go farther into this subject and to take up other tegumentary structures. It is, however, hoped that this brief review will lead to the reading of Keibel's summary already referred to with its bibliography of over one hundred titles.

BIRDS OF THE GALÁPAGOS ARCHIPELAGO: A CRITICISM OF MR. ROBERT RIDGWAY'S PAPER.

By G. Baur,

UNIVERSITY OF CHICAGO.

On the 30th of March, Mr. Ridgway published a paper on the "Birds of the Galápagos Archipelago,"[1] in which he makes the following remarks in regard to the genus Geospiza:

"Few genera equal the present one in the extreme modifications in the form of the bill, which in some species (*magnirostris* and *strenua*) is, perhaps, not excelled by that of any member of the family Fringullidæ in its extreme thickness; in others (members of the so-called genus Cactornis) slender and decurved; in others very acute, with straight outlines, and, in others still, elevated and arched at the base. The most extreme forms are, however, so gradually connected by intermediate types, that there seems no possibility of satisfactorily subdividing the genus into two or more sections. The extreme modifications of the bill and some of the connecting forms are shown in the outline illustrations on plate LVII.

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[1] Proc. U. S. Nat. Mus. (No. 1116), Vol. XIX, p. 459-560, Pl. LVI-LVII, Washington, 1896.

"The reduction of Cactornis to a synonym of Geospiza has already been made in my paper describing the new species of Galápagos birds in Dr. Baur's collection, in which is announced the discovery of species which absolutely bridge the previously existing gap between the so-called genera Geospiza and Cactornis, thus necessitating the suppression of one of those names (the latter, according to the rule of priority). Dr. Baur, who has had the advantage of studying these birds in life, disapproves of this, as the following extract from one of his letters will show: 'I should like to make a few remarks, if you will permit me, about Cactornis and Geospiza. You place the species of these two genera in one genus, Geospiza. I do not think that this is natural. Both have their peculiar representatives on the different islands, and if you place them together, this peculiar differentiation of each is lost sight of. Cactornis is more slender than Geospiza, and has many more black individuals. I would keep the two genera apart, and would not hesitate to place *Geospiza propinqua* in Cactornis.' I am quite willing to adopt Dr. Baur's views concerning the position of *G. propinqua,* which I had compared with *G. conirostris* (a true Geospiza); but, while admitting that it would be very convenient to recognize Cactornis if any definite characters could be found which will serve to separate them. The character which comes nearest to doing so, apparently, the relative width of the mandible between the bases of the rami to the length of the gonys, which is very much less in typical Cactornis than in true Geospiza. This greater compression of the bill even serves to trenchantly separate *Cactornis propinqua* from *G. conirostris,* some individuals of which are almost precisely alike in the lateral profile and measurements of the bill."

	Albemarle I.	Indefatigable I.	James I.	Jervis I.	Duncan I.	Barrington I.	Charles I.	Hood I. Gardner I.	Chatham I.	Tower I.	Bindloe I.	Abingdon I.
Nesomimus	parvulus (Gould)	melanotis (Gould)	melanotis (Gould)	melanotis (Gould)	O	barringtonensis	trifasciatus (Gould)	macdonaldi Ridgw.	adamsi Ridgw.	bauri Ridgw.	bindloei Ridgw.	personatus Ridgw.
Certhidia	albemarli Ridgw.	salvini Ridgw.	olivacea Gould	spec.	spec.	bifasciata Ridgw.	O	cinerascens Ridgw.	luteola Ridgw.	mentalis Ridgw.	spec.	fusca Scl. & Salv.
Pyrocephalus	intercedens Ridgw.	intercedens Ridgw.	nanus Gould	nanus Gould ?	spec.	O	carolinensis Ridgw.	O	dubius Gould.	O	spec.	abingdoni Ridgw.
Cactornis	Spec. (fatigata ?)	fatigata Ridgw.	scandens Gould	spec.	spec.	barringtonensis Ridgw.	intermedia Ridgw.	O	spec.	propinqua Ridgw.	spec.	abingdoni Scl. & Salvin
Geospiza Series I.	strenua-magnirostris Gould	strenua Gould	strenua Gould	strenua-magnirostris Gould.	——	——	magnirostris Gould (Darwin)	conirostris Ridgw.	magnirostris Gould (Darwin)	pachyrhyncha Ridgw.	strenua Gould	strenua Gould
Geospiza Series II.	fortis Gould (albemarli Ridgw.)	fortis Gould	bauri-fortis Ridgw. Gould.	fortis Gould.	fortis Gould	fortis Gould ?	fortis Gould	media Ridgw.	dubia Gould	O	fortis Gould ?	fratercula Ridgw.
Geospiza Series III.	fuliginosa Gould	fuliginosa Gould	fuliginosa Gould	fuliginosa Gould	fuliginsoa Gould	fuliginosa-parvula Gould	fuliginosa Gould	fuliginosa Gould	fuliginosa-parvula Gould	acutirostris Ridgw.	parvula Gould	parvula Gould
Camarhynchus Series I.	variegatus Scl. & Salv.	variegatus Scl. & Salv.	variegatus Scl. & Salv.				variegatus Scl. & Salv. (crassirostris Gould)	O	variegatus Scl. & Salv.	O	bindloei Ridgw.	habeli Scl. & Salv.
Camarhynchus Series II.	affinis Ridgw.	psittaculus Gould	psittaculus Gould incertus Ridgw.	psittaculus Gould compressirostris Ridgw.	spec.	spec.	psittaculus Gould	O		O		
Camarhynchus Series III.	prosthemelas Scl. & Salv.	prosthemelas Scl. & Salv.	prosthemelas Scl. & Salv.	prosthemelas Scl. & Salv.			prosthemelas ? Scl. & Salvin pauper Ridgw.	O	salvini Ridgw.	O		
Tropidurus	albemarlensis Baur	indefatigabilis Baur	jacobii Baur	jacobii Baur	duncanensis Baur	barringtonensis Baur	grayi (Bell)	delanonis Baur	bivittatus (Peters)	O	habelii Steind.	pacificus Steind.
Phyllodactylus	galapagoensis Pet.	——	——	——	——	——	baurii Garm.	——	leei Cope	——	——	——
Schistocerca	melanocera Stål.	melanocera Stål.	melanocera Stål.	melanocera Stål	melanocera Stål.	melanocera Stål	melanocera Stål	literosa punctata Scudd.	literosa discoidalis Scudd.	literosa hyalina Scudd.	——	——
Euphorbia riminea	albemarlensis (eypica)		jacobensis	jervensis		barringtonensis	carolensis		chathamensis	castellana		abingdonensis

I shall show now that the *Cactornis propinqua* Ridgway from Tower Island in the north and the *Geospiza conirostris* Ridgway from Hood Island in the south of the Archipelago have no relationship whatever. The distance between Hood and Tower is one hundred nautical miles. Mr. Ridgway arranges the different species of Geospiza (including Cactornis) in a single line, to show the gradual connection between the different forms. I can not agree with this.

My opinion is the following: All the plastic genera, which are represented only by a single species on each island, as Nesomimus, Certhidia, Pyrocephalus and Cactornis, show peculiar species on nearly every island. The same is true for the iguanoid lizard Tropidurus, the land tortoises, for Phyllodactylus of the Geckonidæ, of the genus Schistocerca of the Orthoptera,[2] and one of the most striking examples is offered by *Euphorbia viminea* Hook. fil. of the Euphorbiaceæ.[3]

But there are genera, like Geospiza and Camarhynchus, which have more than one species on one island—two or three, perhaps four.[4] How can we explain this? I think it is not difficult to answer this question. We simply have to imagine that already, before the splitting up of the Galápagos landarea into distinct islands, there existed at least 3 species of Geospiza and Camarhynchus, each of which became differentiated on the different islands. This shows at once that we can not arrange these species in one series, but in 3 parallel series. In some islands, as will be seen from the table, one or the other form of the 3 series may be missing. This conclusion I reached the 16th of August, 1891, on James Island, and I have published it in 1892.[5]

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[2] Baur, G. The differentiation of species on the Galápagos Islands and the origin of the group. Biological lectures del. at the Marine Biol. Laborat. of Wood's Holl, summer session of 1894. Boston, 1895, p. 67–78.

[3] Robinson, B. L. and J. M. Greenman. On the Flora of the Galápagos Islands, as shown by the collections of Dr. G. Baur. Amer. Journ. Science, Vol. L, August 1, 1895, p. 135–149.

[4] I consider *Geospiza magnirostris* Gould and *G. strenua* Gould as unseparable. Species which are based on a single specimen like *Geospiza dentirostris* Gould, and the locality of which is unknown, are of no use. *Geospiza difficilis* Sharpe must be restricted to Abingdon. This leaves 3 species only for Charles. If there are more than 3 or 4 species of Geospiza said to occur on one island, I have no doubt that there is some mistake.

If Geospiza was represented by three species, when all the islands were still in connection, each of these, after the segregation into different islands, developed its own races, which gradually became species. We always can recognize these three forms if they are present on a single island, and they never intergrade on the same island. We can distinguish three parallel series of Geospiza. First the large forms, represented by *Geospiza strenua* Gould; second, the medium-sized forms represented by *Geospiza fortis* Gould, and, third, the small forms represented by *Geospiza fuliginosa* Gould. The same is true for Camarhynchus. The table shows these different series.

I shall now make a few remarks about the birds from Charles, Hood, Barrington, and South Albemarle, which were contained in a box which disappeared in Guayaquil. The loss is not quite so unfortunate as stated by Mr. Ridgway. He remarks that it contained more than forty land birds from the southern part of Albemarle Island, but this statement, as will be seen from the list which I now give, is not correct. The only two species of birds which are lost are two specimens of Camarhynchus, and the new species of Nesomimus from Barrington Island, of which accidentally no alcoholic specimens were preserved. All the other species contained in the box are represented by alcoholic material.

List of lost specimens from Charles, Hood, Barrington and South Albemarle, and the number of alcoholic specimens preserved :

CHARLES ISLAND.

2 *Dendroica aureola* (Gould), 5 in alcohol.
6 *Geospiza fortis* and *fuliginosa* Gould, 33 in alcohol.
26 *Cactornis intermedia* Ridgw., 8 in alcohol.
11 *Camarhynchus.*
2 *Myiarchus magnirostris* (Gould), 3 in alcohol.

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[5] Baur, G. Ein Besuch der Galápagos Inseln. Biolog. Centralbl. Bd. XI, 1892, p. 248–249.

3 *Pyrocephalus carolensis* Ridgway, 3 in alcohol.

6 *Coccyzus melanocoryphus* Viell.

2 *Nesopelia galapagoensis* (Gould).

HOOD AND GARDNER ISLANDS.

10 *Nesomimus macdonaldi* Ridgw., 1 skin, 9 in alcohol.

1 *Dendroica aureola* (Gould), 2 in alcohol.

6 *Certhidea cinerascens* Ridgw., 5 in alcohol.

7 *Geospiza* sp.; 10 *Geosp. conirostris* Ridgw., in alcohol.

13 *Geospiza fuliginosa* Gould, *in alcohol.*

1 *Myiarchus magnirostris* (Gould), 7 *in alcohol.*

BARRINGTON ISLAND.

11 *Nesomimus* n. sp.

3 *Dendroica aureola* (Gould), 2 in alcohol.

1 *Certhidia bifasciata* Ridgw., 3 skins from alcoholic specimens.

4 *Geospica*, 11 in alcohol.

7 *Cactornis barringtonensis* Ridgw., 3 skins from alcohol, 1 alcoholic.

2 *Camarhynchus* spec.

2 *Myiarchus magnirostris* (Gould), 4 in alcohol.

SOUTH ALBEMARLE ISLAND.

3 *Nesomimus parvulus* (Gould), 6 skins and 2 in alcohol.

6 *Dendroica aureola* (Gould), 6 in alcohol.

3 *Certhidea albemarlei* Ridgw., 2 skins, 2 in alcohol.

15 *Geospiza* (No. 316, large black; No. 336 large black, fine; No. 358,366, large black); (3 medium size, 8 small).

6 *Geospiza strenua* Gould, in alcohol.

10 *G. fortis* Gould in alcohol.

44 *G. fuliginosa* Gould in alcohol.

8 *Camarhynchus* (3 large, 5 small), 11 in alcohol.

6 *Cactornis fatigata* Ridgw., 6 in alcohol.

2 *Cactornis productus* Ridgw., 2 skins are preserved.

4 *Myiarchus magnirostris* (Gould), 2 in alcohol.

3 *Pyrocephalus intercedens* Ridgw., 1 skin preserved, 8 in alcohol.

2 *Himantopus mexicanus* (Müller), 2 skins are preserved.
1 *Coccyzus melanocoryphus* Vieill.
1 *Nesopelia galapagoensis* (Gould).

ADDITIONS TO THE LIST OF BIRDS GIVEN BY RIDGWAY FOR THE DIFFERENT ISLANDS.

ALBEMARLE ISLAND.

Ridgway enumerates 35 species from Albemarle, and remarks: "As Dr. Baur and his associate, Mr. Adams, collected more than forty species in South Albemarle, there are, at least, twenty-five species found there which are, as yet undetermined. I cannot support this statement. Ridgway himself names 33 species collected by us. The following have to be added : *Progne modesta* Néboux, *Coccyzus melanocoryphus* Veillot, *Fregata aquila* (Linn.), *Ardea herodias* Linn., *Phoenicopterus ruber* Linn., *Nesopelia galapagoensis* (Gould), *Larus fuliginosus* Gould, *Aestrelata phaeopygia* Salvin., *Procellaria tethys* Bonaparte.

The large white heron, of which I saw four specimens in South Albemarle and one in East Albemarle opposite Cowley Island, is certainly not a white phase of the large gray heron, but *Herodias egretta* (Gmelin). I have observed different specimens of *Ardea herodias* (Linn.) on South Albemarle. We have therefore, in all, 42 specimens of birds on Albemarle, and I do not believe that this number will be much increased, at least in the land birds, by further examination.

BRATTLE ISLAND.

This very small island is very close to South Albemarle. Besides *Sula nebouxii* Milne-Edwards and *Creagrus furcatus* (Néboux), *Fregata aquila* (Linn.) breeds there. There are also a few small land birds (Geospiza).

DUNCAN ISLAND.

To the 9 species mentioned by Ridgway the following have to be added. *Cactornis pallida* Scl. and Salv. (?) besides the black *Cactornis* sp.; *Progne modesta* (Néboux), *Asio galapagoensis* (Gould), *Fregata aquila* (Linn.), *Pelecanus californicus* Ridgway, *Sula nebouxii* Milne-Edwards; *Anous galapagoensis* Sharpe, *Aestrelata phaeopygia* Salvin, *Procellaria tethys* Bonaparte.

CHARLES ISLAND.

Arenaria interpres (Linn.); *Haematopus galapagoensis* Ridgw., *Oceanites gracilis* Elliot).

HOOD ISLAND.

Fregata aquila (Linn.) and *Phaëthon aethereus* Linn.

GARDNER ISLAND,[6] NEAR HOOD.

Nesomimus macdonaldi Ridgw., *Certhidia cinerascens* Ridgw., *Geospiza conirostris* Ridgw., *Geospiza fuliginosa* Gould, *Haematopus galapagoensis* Ridgw., *Nyctanassa violacea* (Linn.), *Anous galapagoensis* Sharpe.

STEEP ROCKS BETWEEN GARDNER AND HOOD.

Creagrus furcatus (Néboux), breeding.

CHATHAM ISLAND.

Cactornis pallida Scl. and Salv., possibly a new species; *Phaëthon aethereus* Linn., *Aestrelata phaeopygia* Salvin, *Procellaria tethys* Bonaparte.

BARRINGTON ISLAND.

Progne modesta (Néboux), and between Barrington and Indefatigable, *Creagrus furcatus* (Néboux), *Phaëthon aethereus* Linn. and *Diomedea* spec.

INDEFATIGABLE ISLAND.

Ardea herodias Linn., *Pelecanus californicus* Ridgw., *Oceanites gracilis* (Elliot).

NEAR SEYMOUR ISLANDS,

Forming the most northerly point of Indefatigable: *Creagrus furcatus* (Néboux), *Phaëthon aethereus* Linn. and *Diomedea* spec.

JERVIS ISLAND.

Geospiza strenua-magnirostris Gould; *G. fuliginosa* Gould, *Cactornis pallida* Scl. & Salvin, *Buteo galapagoensis* Gould, *Pele-*

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[6] This is not Gardner Island, which is a small rock east of Charles Island. This fact shows at once that the *Nesomimus* found here is not *N. trifaciatus* (Gould) as supposed by Ridgway, p. 478, p. 481, but *N. macdonaldi* Ridgw. The specimens are not lost.

canus californicus Ridgw., *Sula nebouxii* Milne-Edw., *Larus fuliginosus* Gould, *Anous galapagoensis* Sharpe, *Nesopelia galapagoensis* (Gould).

JAMES ISLAND.

Pelecanus californicus Ridgw., *Creagrus furcatus* (Néboux), (Sullivan Bay, N.-E. end), *Spheniscus mendiculus* Sundevall.

TOWER ISLAND.

Haematopus galapagoensis Ridgw., *Butorides plumbeus* (Sundev.), *Phaëthon aethereus* Linn. Mr. Ridgway states p. (600) that there were no specimens in the Baur-Adams collection; this is not correct; six fine skins were secured.

BINDLOE ISLAND.

Camarhynchus bindloei Ridgw., which was based on our specimens, is placed in Habel's column. My list is: *Nesomimus bindloei* Ridgw., *Dendroica aureola* (Gould), *Certhidia* spec., *Geospiza strenna* Gould, *Geospiza fortis* Gould, *Geospiza parvula* Gould, *Cactornis assimilis* Gould, *Camarhynchus bindloei* Ridgw., *Myiarchus magnirostris* (Gray), *Pyrocephalus* spec., *Asio galapagoensis* (Gould), *Buteo galapagoensis* (Gould), *Fregata aquila* (Linn.), *Pelecanus californicus* Ridgw., *Sula nebouxii* Milne-Edw., *Sula brewsteri* Goss, *Nesopelia galapagoensis* (Gould), *Haematopus galapagoensis* Ridgw., *Nyctanassa violacea* (Linn.), *Arenaria interpres* (Linn.), *Larus fuliginosus* Gould.

ABINGDON ISLAND.

Besides *Nesomimus personatus* Ridgway, the only bird mentioned as ascertained by us, the following species were collected: *Certhidia fusca* Scl. and Salv., *Geospiza fratercula* Ridgw., *G. parvula* Gould, *Cactornis abingdoni* Scl. and Salv.; and the following birds were observed: *Buteo galapagoensis* (Gould), *Fregata aquila* (Linn.), *Pelecanus californicus* Ridgw., *Butorides plumbeus* (Sundevall), *Creagrus furcatus* (Néboux).

One set of the Baur-Adams Collection is at Clark University, Worcester, Mass., but the bulk of the collection has gone to the Zoological Museum at Tring.

THE ADVANCE OF BIOLOGY IN 1895.

By C. B. Davenport.

The publication of *L'Année biologique* for 1895, which is described in another column, gives us an opportunity to make use of the admirable summaries of the chapters to summarize still further the advance of general biology in 1895.

Cytology.—The group of unnucleated organisms was still further diminished by Nadson's discovery in Cyanophyces of chromatin-like granules diffused throughout the cell, but arranging themselves during cell division in a way recalling karyokinesis. The idea of the permanent nature of the centrosome in the cell was strengthened by finding it in resting cells of many plant and animal tissues. The identity of centrosome and nucleolus in the infusorian *Spirochona* was insisted upon by Balbiani.

In the study of cell-division we find the year characterized by the variety of material employed—the attempt to build up a broader comparative knowledge upon the basis of well-studied types. The nuclear origin of the spindle was strongly maintained by Strasburger and others against the prevailing view. New variations in the method of splitting of the chromosomes were described. The mechanical (rather than the magnetic or chemotatic) explanation of the intracellular movements seemed to gain favor. The nature of the archoplasm, whether a part of the cytoplasm or different, was left in debate. New intermediate conditions uniting direct and indirect nuclear division were described and the great variety in the karyokenetic process was becoming generally recognized.

The sexual products and fecondation.—The question of chromatic reduction before the introduction of new chromatin by fertilization attracted many workers, and new data were obtained on the number of chromosomes in different species, the time at which reduction takes place and the details of the method. New methods of formation of the tetrads by conjugation were described by Wilcox, Calkins and others.

In our knowledge of *fecondation* great advance was made, largely by American workers. The derivation of the archoplasm of the fertilized egg exclusively from the sperm was confirmed upon many organisms; but Wheeler found in Myzostoma a case of the persistence of the archoplasm of the ovum only. The independence of the nuclear matter derived from the two germ cells united in fecondation was shown by Rückert to be indicated in Cyclops by the bilobed condition of the nucleus, even to the period of formation of the germ layers.

Parthenogenesis.—The accepted view that the unfertilized hen's egg may go through the early cleavage stages was shown by Barfurth and by Lau, independently, to rest upon errors in observation.

Ontogenesis—The contributions to the preformation-epigenesis controversy were among the most important of the year, pointing to a common ground for both sides, one, consequently, which probably lies near the truth. Driesch and Morgan, opponents of Roux's form of the theory of preformation, found in the Ctenophore an organism in which, when one of the two blastomeres is isolated, the other develops into a partial larva. This indicated a degree of preformation, but not the degree held by Roux; for, first, more than half of the larva was produced from the $\frac{1}{2}$ blastomere, and, secondly, when a piece was cut out of the fertilized but unsegmented egg, there was still a defect in the larva. The conclusion was: There is a rough preformation in the *cytoplasm*, but not, in addition, a qualitative divison of the nucleus as Roux supposes. On the other hand, Zoja found that a whole medusa developed from even a $\frac{1}{16}$ blastomere. We must recognize, consequently, a series in the capacity of developing a whole from a part, of which the medusa occupies one extreme and the ctenophore the other. Studies on amphibian eggs were made by Morgan, who found that half or whole embryos may be obtained from the $\frac{1}{2}$ blastomere, according as the contents of the egg preserve their normal positions or become intermingled by inverting the egg, and by Herlitzka, who found that the isolated $\frac{1}{2}$ blastomere of Triton develops like the entire egg. All the facts seemed to point to a combined action of epigenesis and evolution in development.

The limiting size of the egg consistent with development was studied by Morgan, who found that one-fiftieth of an uncleft echinoid egg would develop, and by Loeb, who believed one-eighth of the total mass of the egg is necessary to the formation of the pluteus, while, in the presence of nucleoplasm, the very smallest quantity of cytoplasm is capable of growth and organization.

The theory that development is controlled by responses to stimuli was extended by Herbst and by Davenport to particular developmental processes. Roux brought forward his observations on the migration of isolated blastomeres with reference of each other—cytotropism; these migrations resembling those of zoospores towards and from each other (Hartog, Sauvageau). Advance was made in interpreting, on the ground of functional activity, the details of the form of the skeleton (Hirsch) and especially of the joints (Tornier).

Teratogenesis.—Double monsters were produced in frogs by inversion, which mixes up the contents, and in echinoids, by immersing the egg in a salt solution and thereby producing an " extraovat." The effects of low temperature upon development were studied in detail upon frogs and the chick; magnetism was shown again to have little or no effect upon development, while electricity has (Windle); abnormal density of solutions caused spina-bifida and other abnormalities in the tadpole (Hertwig, Gurwitsch). The capacity for development of enucleated egg-fragments into which a spermatozoan has penetrated was reasserted, as a result of new studies, by Boveri.

Regeneration.—Progress was made along three lines: the distribution of the capacity for regeneration, the comparison of regeneration and ontogeny, and the explanation of regeneration. As for the distribution of the regeneration capacity, new cases were described of the regeneration of internal organs (spleen of rabbit, liver of mammals)—not subject to accidental amputation. Failure to regenerate was reported of the thyroid gland and nerve cells in vertebrates. Experiments revealed a capacity for regeneration in the nervous system of earthworms, the trunk segments of pantapods, and the body of ascidians. It became clearer that regeneration may proceed along very different lines from normal ontogeny—Wolff found the crystalline lens regenerating from the edge of the iris instead of the outer skin. Girard found that well-fed and much exercised tritons regenerate polydactylic feet.

Concerning the cause of regeneration, Nussbaum concluded that both regeneration and heteromorphosis depend upon indifferent cells in the body; Loeb suggested that regeneration depends upon special organogenic substances (Sachs); and Rauber compared in much detail organic regeneration to that of a crystal and believed a causal relation to lie behind the similar phenomena.

Grafting.—This year will be remembered as that in which Born published the results of his marvelous experiments on uniting bits of tadpoles belonging even to different families. Important also are the experiments of Wetzel who obtained from his grafts of hydra additional evidence for the polarity theory.

Polymorphism, metamorphosis and alternation of generations.—Advance was made (1) in the interpretation of many varieties as polymorphic forms; (2) in the determination of polymorphic forms by external conditions, and (3) in the discovery of a hidden alternation of generations in organisms. For the first, Coutagne showed for molluscs and Standfuss for mosses that similar varieties, due to the same causes, recur so frequently in different species that a few suffixes applied to the different specific names will suffice to designate all varieties. As for the second, Dietel showed that, in the Uredineæ, the succession of aecidio-, uredo- and teleutospores may be varied at will; Wasmann got intermediate polymorphic forms in ants by intermediate food conditions, and Bachmann modified, by changing the character of the substratum, the form of the sporangia of *Thamnidium.* As for the third, the idea of Strasburger (1894) was developed by others, so that the theory now seems well formulated that, as in the vascular cryptogams and the phanerogams, so also in all animals there is an alternation of generations, the sexual generation including the four cells arising from the oögoumni—a rudimentary generation corresponding to the rudimentary sexual generation of angiosperms—and a non-sexual generation, which comprises the soma, each of whose nuclei has double the number of chromosomes found in the sexual generation.

Correlation.—The development of the doctrine of internal secretions was the most important contribution of this year to the theory of correlation. Especially were the effects on other organs of the removal of the sexual glands, the thyroid, the superrenals, and the digestive glands carefully studied; and the obliteration of these effects, by feeding extracts of the tissues, observed. The specific action of one part of the organism upon the other parts was being unravelled.

General morphology and physiology.—This year witnessed the memorable discussion between A. Sedgwick and Bourne as to the morphological value of "cells," which served to emphasize their physiological significance. To the subject of budding we have the contributions of Chun, who showed that, in the medusæ, both layers of the bud may be derived from one layer only (the ectoderm); thus another blow was dealt to the germ layer theory.

Especially memorable was the year for the appearance of Verworn's "Allgemeine Physiologie," which, in one leap, gave scientific standing to that subject, and of LeDantec's "La matiére vivante," much less extensive, but in the ground it covers, more profound; both works are dominated by the idea of the chemical nature of vital phenomena. The numerous papers on general physiology related to various subjects, especially general cell-physiology, muscle contraction, phagocytosis, effect of external agents on organisms, geotropism (Czapek), heliotropism, thermotropism (Mendelssohn), nutrition, cell respiration (Loeb and Hardesty), immunity, toxines and ferments.

Heredity.—The year saw much discussion of the inheritance of acquired characters and the theory of heredity, but little progress. The experiments of Charrin and Gley afforded another example of transmission (but rare and incomplete) to the first generation of the effects of vaccination. Hyatt published in full his palæntological evidence that an impression in the shell of fossil Ammonites, due to crowding of coils, persists in (abnormally) uncoiled species. A masterly discussion of the whole question of inheritance of acquired characters appeared this year in Romanes' "Post-Darwinian Questions."

Variation.—If little new was added to our knowledge of heredity, such was by no means the case with variation. New facts were acquired, new methods of study employed, new experimental investigations made to determine its cause.

Osborn classified variations as ontogenetic (and either gonagenic, gamogenic, embryonic or somatogenic) and phylogenetic. Scott distinguished between individual variation (of ontogenetic value only) and mutation (of phylogenetic value).

Mehnert showed that variation occurs as abundantly in embryos as in adults. Eigenmann showed that in certain fishes the variants above the mode are more abundant than those below, and that individual variation is greatest where the number of species is greatest. The extraordinary variation of medusæ was investigated by Browne.

The development of the mathematical study of evolution, for which this decade will ever be famous, took a great stride in the publication of Pearson's "Skew Variation," by which methods of measuring unsymmetrical variation curves, their variability and their skewness were given. Since most biological curves are skew curves, this method greatly extends Galton's, which was applicable only to symmetrical curves. DeVries studied quantitatively a case of dimorphism in plants, and Weldon investigated selection in crabs.

Among the studies on the causes of variation may be mentioned the experiments of Vernon on echinoderm larvæ; of Weismann, Standfuss, Ris and, especially, Fischer (similar effect on heat and cold), upon lepidoptera; of Bonnier on plants subjected to electric light (producing excess of chlorophyll and scragged form); and of Goebel, who found that when cacti with foliaceous stems were grown in the dark the stems became rounded. Davenport and Castle found that tadpoles have the capacity for self-adaptation to heat.

As for variation due to internal causes, Meyer determined that despite its fewer chromosomes, *Ascaris univaleus* is as variable as *A. bivalens*, which is opposed to Weismann's theory. Brooks pointed out apropos of amphimixia that the number of ancestors of an individual does not roll up according to the formula 2^n (in which the power ^{n} represents the number of generations) because of constant intercrossing of relatives.

Origin of species.—A trend towards facts is clearly discernable in the work of the year on this subject. Natural selection was tested by the statistical method (Weldon). Galton called for facts concerning sports and their pedigree, a call which should not be unheeded by American naturalists. One such case, excellently traced, was given in 1895 by Tracy in the AMERICAN NATURALIST. Aerial discussions still went on, however. Wallace still thought that specific differences arise by the summation of slight variations, and Henslow still maintained the view that they arise from considerable self-adaptive changes.

Mental functions.—The differentiation of comparative physiological psychology from "metaphysics" made good progress during 1895. Lloyd Morgan did much to give to instinct a satisfactory biological definition. Among special works on the senses of animals may be mentioned the Peckhams' observations, showing that spiders recognize each other by sight, and Riley's experiments with moths, in which a marked male found a female a mile and a half away. Hodge and Aikins gave the records of the activities of a single Vorticella observed during several consecutive hours.

Studies in the ontogenesis of mental functions were made by Mills on the dog, and he and Lui agreed that there is a close parallel between the appearance of certain functions and the visible development of corresponding cortical centres. Baldwin had followed carefully the mental development of a child and laid great stress upon the rôle of imitation in the process. The development of memory, especially visual memory, and the formation of abstract concepts were also studied.

General theories.—This year was productive of no new guiding theories. It was still reasserted that it is vain to seek further than for a teleological explanation of biological phenomena. Weismannism was much attacked and much mended. Cope issued several articles foreshadowing his now well-known book. Whitman showed from the history of the discussion, epigenesis *vs.* evolution, how the grounds of debate have completely changed.

In glancing over the work of the year, we see that the great advances were made in cytology in the broad sense, in the interpretation of the causes of the early ontogenetic changes, in the general physiology of organisms, in the experimental determination of form and in the quantitative study of variation. All of these are subjects little considered a decade or two ago. It is noticeable also that, although general biology has long been regarded as a free field for all speculators, the greatest activity among workers and the richest results are found when the students of fact are busy. This is the most hopeful sign for the future.

THE SWAMPS OF OSWEGO COUNTY, N. Y., AND THEIR FLORA.

By W. W. Rowlee,

CORNELL UNIVERSITY, ITHACA, N. Y.

(Concluded from page 699.)

THE LAKES.

In the region of our typical swamps these lakes are frequently of considerable depth. Usually, however, they are comparatively shallow. Stories are told here, as elsewhere, of "bottomless lakes" where a line, no matter how long, would not reach the bottom. The fine mud in the bottom was, in all probability, the cause of the deception. At the bottom of the lake the mud is as mobile as water, and it is difficult to determine where fluid ends and solid begins, and hence the difficulty in sounding. There are at least three lakes in this region called Mud Lake, a fact which testifies to their character. One is Mud Lake in Oswego town already described, another is in Scriba in the same county two or three miles south of the

Lily Marsh, and the third is near Baldwinsville in Onondaga County.

The mud of the swamps gives a decided character to the streams of the region. Whether a stream rises in the lake or flows through it or any other part of the swamp, the water is colored by the mud a dark yellow or wine color. This color of the water of many of the streams led to the application of appropriate names, such as Wine Creek, Mud Creek and Black Creek.

THE LAKE FLORA.

While the flora of the lakes present many interesting features, the plants are much less unique than those of the surrounding moor. Aquatic plants have long been noted for their wide distribution. Darwin has pointed out that this depends upon the distribution of their seed by birds. While we are ready to accept this as one of the means by which the plants disseminate themselves, we must also assert that the ultimate causes of this is the similarity of conditions presented by aquatic conditions generally. The conditions are very much the same in our lakes as in other similar bodies of water, such as slow flowing streams and lakes with hard shores. Aquatic floras are, however, quite distinct from terrestrial ones of the same region. The moors surrounding our lake come very near affording aquatic conditions. Nevertheless the shore line between lake and moor is a pretty definite one. The following are species representative of the lake flora:

The *Naiadaceæ* afford a characteristic group belonging here. None of them find congenial conditions outside the bounds of the lake, and most of them are confined to water several feet deep. *Potamogeton amplifolius, P. lonchites and P. heterophyllus* are in the latter class, while *Naias flexilis* and *P. foliosus* approach nearer the shores.

Vallisneria spiralis is a plant which does not appear very near the shores.

Eleocharis mutata must be considered, at least in this region, a lake plant, as at Lake Neahtahwantah and Paddy Lake, our only stations for it, it grows only in water. It seems essential, however, that its roots only should be submerged ; the culms always appear above water, and consequently it occurs only upon rather shallow shores.

The Lemnaceæ are represented in the lakes by *Lemna trisulca*, *L. minor* and *Spirodela polyrhiza*, none of which make any attempt to grow in the bog.

Eriocaulon septangulare is one of the few plants that are common to the lake and the moor, in fact, it is about the only one. Whether it grows upon sand in a few inches of water, or upon the soft mud in the newest portions of the moor, it seems equally at home. I have found it growing in four lakes in the county, but never saw it in a swamp where there was no lake. Paine says (Cat. of Plants of Oneida Co.), of the distribution of this plant, "Lakes and ponds of the north woods, throughout and common." I conclude, therefore, that the plant is, in this region, a lake plant.

Heteranthera dubia is a deep water plant, and grows in these lakes as well as in slow flowing streams.

The whole order Nymphæaceæ is a water-loving group. With rare exceptions it is confined to the shallower portions of the lake. The exceptions are cases where the strong rootstock of *Nymphæa* and *Castalia* have persisted after the moor has advanced into the lake beyond them and sends up, for a few years, its leaves and flowers through the thin turf. The contrast between the black mud of the moor and the pure white flowers of *Castalia* is very striking. *Brasenia purpurea*, *Castalia odorata*, *Nymphæa advena* are the representative plants. The depth of water in which these plants grow ranges from one to six feet, only rarely going outside these limits.

Myriophyllum spicatum is a well-known aquatic finding a place here.

The Lentibulariaceæ is represented by two species in the lakes and several others in the moor. None of its species are common to both lake and moor. *Utricularia vulgaris* and *U. minor* are the lake plants. While occurring in other places, they thrive particularly well in the muddy lakes surrounded by moors.

And, finally, for the order Compositæ, we have, in our lakes, a single representative in *Bidens beckii*.

THE FLORA OF THE MOOR.

There is no group of plants more interesting from the point of view of their geographical distribution than the one which constitutes the moor flora. Allusion has already been made to the probable post-glacial history of the flora; and attention has also been called to its relation to the Alpine flora of New York State. The general fact that the two floras approach each other toward the north until we find them closely associated in Arctic regions, is pretty conclusive evidence of closer association in post-glacial times. But their limited distribution and their relation to our Alpine flora is no more interesting than their distribution in the moor itself. Some of the plants are restricted to the newer portions of the bog; others are only found in the older portions. Those of the newer portion are, in general, the invading plants; those of the older portion sometimes persist in the wooded belt. In the older portions of the bogs there sometimes appear upland plants. A general survey of the species may here be made.

The *Juncaginaceæ* are all marsh plants. In our region they are, so far as I know, mainly confined to the newer portion of the sphagnous moors. *Triglochin maritima* occurs at Mud Lake, Oswego town, "Paradise," So. Mexico, Granny's Orchard, Palermo, and other places. According to the Manual (Gray's) it occurs at the seashore and in saline places across the Continent. Mud Lake is by no means a saline place. *T. palustris* has not been seen, so far as I know, in Oswego County, but occurs at Junius, Seneca County, in the same basin, also upon the "boggy borders of Onondaga Lake; at Salina, and northward beyond Liverpool" (Paine, l. c., p. 81). *Scheuchzeria* occurs in the newer portions of all our sphagnous moors.

There are but few *grasses: Phragmites, Muhlenbergia racemosa, Panicularia canadensis* and *Calamagrostis canadensis* are frequently found in the moors, but are not confined to them.

On the other hand the *Cyperaceæ* is one of the best represented orders. Here, and here almost exclusively, the species of woolgrass (Eriophorum) grow. One of the most effective bog-making plants in this region is *Carex filiformis*, the rootstocks of which form a very strong warp into which other plants are woven. It presses up close to the margin of the lake, and affords a pretty sure indication as to whether it is safe to venture upon the place or not. Other characteristic carices are *C. pauciflora, C. teretiuscula, C. magellanica, C. limosa, C. exilis* and *C. redowskyana.* Other species of Carex, as well as some species belonging to other genera in this order, are often found in the bog.

Peltandra virginica is in the moors, but occurs as well along all our streams. Calla, while perhaps not exclusively a moor plant, occurs here more frequently than anywhere else.

But a single species of the *Liliaceæ* is found, viz.: *Vagnera trifolia.*

In distinct contrast we find this the chosen home of our rarest orchids. The representative species are: *Habenaria blephariglottis, H. clavellata, H. dilatata, H. leucophæa, Cypripedium reginæ, Pogonia ophioglossoides, P. verticillata, Arethusa bulbosa, Gyrostaichy romanzoffiana, Listera australis* and *Limodorum tuberosum.*

Two willows, *Salix myrtilloides* and *S. candida*, are exclusively moor plants in this region.

Sarracenia purpurea is confined to the moors, and is one of the most unique in appearance and habits of moor plants.

Drosera intermedia occurs only in the newest portions of the moor, while *U. rotundifolia* is more often in the drier portions, sometimes even growing upon rotten logs at the margin.

Three of the *Rosaceæ* are conspicuous moor plants. *Comarum palustre* is usually upon the water's edge, and is a pretty effective moor builder. The other species are *Geum rivale* and *Sanguisorba canadensis*, both of which are in the more mature portions.

Decodon verticillatus occurs in considerable abundance in most of the lake-containing swamps, but, as is well-known, is not confined to them. It is also an important moor builder.

Two species of Epilobium are confined to the moors—*E. lineare* and *E. strictum.*

Proserpinaca palustris must also be included here.

The *Ericaceæ* is one of the three most conspicuous orders in the moors. The other two are the sedges and the orchids.

The species here which are exclusively moor plants are: *Ledum Groenlandicum, Kalmia glauca, Andromeda polifolia, Chamædaphne calyculata, Chiogenes hispidula, Schollera oxycoccus* and *S. macrocarpa.* Many others, especially species of Vaccinium, live in the moor, but are not confined to them.

Menyanthes trifoliata is a moor plant, and is not uncommon in our region.

The *Lentibuliariaceæ* contribute to this group *Utricularia cornuta, U. gibba, U. intermedia* and *U. resupinata,* all of which are rare plants and grow only in the newer portions.

In the order *Compositæ,* but three species can lay claim to being exclusively moor plants. These are *Solidago ohioensis, S. uliginosa* and *Aster junceus.*

THE FLORA OF THE WOODED BELT.

The third zone of the whole swamp is still to be considered. To attempt to enumerate the species as has been done in the case of the bog and the lake would contribute little to our picture of the swamp as a whole. The species are, for the most part, the same as may be found upon the surrounding uplands, especially in low places. In fact, we may say that just as the moor is steadily invading the lake, so the wooded belt is invading the moor, and there is by no means the sharp limitation to the outer edge of the wooded belt that there is to the outer edge of the moor or of the lake. It is always a tree-covered tract in the natural state, the size of the trees increasing as one passes from the edge of the moor to the hard shore. The trees which appear most frequently are *Ulmus americana, Acer saccharinum, Fraxinus nigra, Pinus strobus, Thuya occidentalis, Larix laricina, Picea mariana* and *Betula lenta.* Of these the predominating species are the first three or four. Shrubs are more abundant in the more open portions near the moor. *Lindera Benzoin, Ilex verticillata, Ilicioides mucronata* and several species of *Vaccinium* are the most prominent. The herbaceous the wooded belt is not a very rich one. Caltha often covers flora of the ground. The most prominent plants are the Osmundas, which grow in rank profusion. *Smilax hispidia, Arisæma triphyllum, Dalibarda repens, Trientalis americana, Medeola vir-*

giniana and many others also grow here. As might be expected, it is a flora made up of species which are by no means confined to this particular place. Some of them flourish equally well upon the surrounding uplands; a few grow in the open moor; many grow in low grounds that do not have the vegetable accumulations characteristic of these swamps.

THE DISAPPEARANCE OF SPECIES WITH THE MATURING OF THE BOG.

The rareness of some of the bog plants attest the gradual disappearance of species from these places. Specimens of *Listera australis* were found by Father Wibbe at the Lily Marsh in New Haven in 1877, where he reported it as growing abundantly.[2] The writer has visited the same place several times since 1888, and has failed to find it again. It is safe to say that it is not abundant there now. A few plants were found by the writer in "Granny's Orchard," in Palermo, in 1895. Here continued and careful search resulted in the finding of but a few plants. Dr. W. M. Beauchamp has found the same species growing at Mud Lake near Baldwinsville, Onondaga County. Here, too, only a few specimens were found. These are, so far as known, the only stations for this species north of New Jersey. It is significant that a considerable number of species, not only those that affect bogs, but some Upland ones, have the same general range as *Listera australis.* The most conspicuous of these are: *Rhexia virginica, Nyssa aquatica, Eriocaulon septangulare, Triglochin maritima, Xyris montana, Scheuchzeria palustris* and several of the *Utricularias.* It seems a reasonable inference that formerly there existed in these regions conditions much more congenial to these plants; that then they were more abundant and continuous in their range than now, and that they have settled in the limited tracts which afford them a congenial home. The conditions which conduce to their persistency are no doubt complex. The main ones, however, seem to be a constant and abundant humidity in the air and abundant moisture in the soil, and, at the same time, a relatively even temperature throughout the year. Humidity in the air is maintained by the extensive surface of the sphagnous moss from which it steadily evaporates great quantities of water. Many plants, especially the delicate orchids, are found only in the moss. The humidity of the air immediately at the surface of the moss at once suggests the conditions in the tropics where the epiphytic orchids thrive.

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[2] Bull. Torr. Bot. Club, VI, 192.

COMMERCIAL VALUE OF THE BOGS.

The capacity of the moss to hold moisture and the evenness and freedom with which it gives it up, has led to its extenstve use in packing the roots of plants during shipment. In the Lily Marsh and Mud Lake in Oswego township, the moss has been removed from a large part of the moors. The effect upon the bog itself is anything but wholesome. By this treatment a clean, mossy moor is turned into a stinking, sour, unsightly and treacherous mud-hole. Nowhere did I ever see such violence done to nature as where the moss is removed from a moor. The traditional woodman's axe does not compare; a burnt forest soon recovers itself to a certain extent; but a bog from which the moss has been taken reclothes itself very slowly, and will probably never become a thick turf as originally. Certainly none of the rarer plants will endure such treatment.

CONCLUSIONS.

1. Swamps form one of the striking and important topographical features of Oswego County.

2. These may consist of a lake, a moor and a wooded belt but in many the lake has been converted into a moor, and in others both lake and moor have passed over into wooded tracts.

3. The surface of the county was fluted by the ice; this determines the outline of all the swamps.

4. The finely pulverized remains of plants (mud) are stirred up with every wind, so that material is constantly shifted from the muddy shores to deeper water.

5. The agitation of the water by the wind has two important influences on the shore: its violence prevents sphagnum from growing at the water's edge; Cassandra, sedges and Decodon, with others, form a barrier at the edge; second, it pre-

vents plants from gaining a foot-hold on the eastern shores where the lakes are of considerable size.

6. The flora of the moor has among its species some of the rarest plants of the region.

7. A considerable number of species otherwise confined to the Atlantic coast occur here. It does not follow, as Paine asserts (l. c., p. 92), that a maritime bay occupied this depression.

8. The distribution of moor-loving plants suggests that once conditions of humidity and temperature enabled them to grow very much more abundantly than now.

9. The commercial value of the moss bids fair to devastate the moors, and their recovery will, of necessity, be very slow.

EDITOR'S TABLE.

With the present number the AMERICAN NATURALIST comes into the possession of new proprietors and under the charge of new editors. We do not propose to make promises of improvement; but shall leave the journal to speak for itself upon that score. We do think it due to our readers, however, to state our convictions as to the position the NATURALIST should occupy in the future.

As we see it, there are, under existing conditions in science, only three kinds of scientific serials that can hope to prosper. There is, on the one extreme, the technical journal devoted to a single strictly defined subject and intended as a repertory of the results of research. At the other extreme is the popular scientific journal which seeks to interest and instruct those who are without specific scientific training. Lastly, between these extremes, comes the general scientific journal which holds a distinct position; it is intended for the students and workers in science—a constituency which has already attained considerable size in this country and is rapidly growing. The NATURALIST aims at being such a journal with such a constituency.

The objection may be made, however, that this constituency is an ill defined one and is without common needs. There are two answers to this objection; the *á priori* answer and that of experience. The *á priori* answer is that, despite the fact that science is becoming more differentiated, its separate disciplines are expanding and coming to overlap. Especially is this true of the natural sciences. The fusion of the biological sciences is wellnigh complete; and they, in turn, grade into geology through geographical distribution and physical geography on the one hand, and through palæontology on the other. All of the natural sciences, moreover, must seek for their bases within the realms of chemistry and physics. Indeed in the development of the new fields of biological geology, chemical geology, bio-chemistry, and bio-physics we can foresee the clearer and more general recognition of the solidarity of the sciences.

The answer of experience is not less decisive. No one can doubt that journals of that class in which *Nature, Science, La revue scientifique,* and *Naturwissenschäftliche Rundschau* are notable examples, meet a perfectly well defined need, and their prosperity gives us hope for success. We accept the answers *á priori* and *á posteriori* and fear no lack of a constituency.

One other point. Every scientific man, as such, may well read two general scientific journals, the weekly scientific newspaper and the monthly review of scientific progress. We recognize that the first of these is already admirably supplied in this country; we believe that THE AMERICAN NATURALIST should furnish the second.

Certain matters of detail are determined by the proposed position of the NATURALIST. We cannot publish very technical works but shall welcome such results of research upon the broader problems of the sciences as may be expected to interest a large share of our readers. For example, it would be inconsistent with our plan to publish a minute description of some anatomical feature or a mere list of the species found in some region; unless, in the first case, the subject should appear to have broad morphological or physiological bearings, or, in the second case, owing to the interesting character of the types or some peculiarity of their distribution, the list should be shown to have exceptional value. On the other hand, papers intended for beginners, such as, "Some birds of the garden," "Some common weeds," are not appropriate for this journal. What we desire is scientific papers written by scientific persons and of interest to scientific workers in more than one field. In addition to results of research, we shall look for summaries of progress in natural science, discussion of scientific questions of the day, and reviews of books and the more important papers. Remembering our title, while not forgetting that science is cosmoplitan, we shall seek especially the advancement of natural science in America.

Such, then, is our programme. To carry it out we invite the coöperation of every American naturalist.

It was a very natural thing that Delage, after going over the ground that he did in the preparation of his great work on "Les grands problèmes de la biologie générale" should see the need of frequently gathering together and classifying the widely scattered data belonging to this field; and thus came into existence the new annual, *L'Année Biologique*, whose first number lies before us.

Its scope is very broad. There are twenty general subjects treated in twenty chapters. These subjects are: 1, the cell; 2, the sexual products and fecondation; 3, parthenogenesis; 4, asexual reproduction; 5, ontogenesis; 6, teratogenesis; 7, regeneration; 8, grafting; 9, sex and secondary sexual characters; 10, polymorphism, metamorphosis, and alternation of generations; 11, latent characters; 12, correlation; 13, death, immortality, and the germ-plasm; 14, general morphology and physiology; 15, heredity; 16, variation; 17, the origin of species, phylogeny; 18, the geographic distribution of species; 19, mental functions; 20, general theories–generalities.

The organization of the journal is as follows: Professor Delage is the director of the serial, Dr. Georges Poirault is secretary of the "Redaction," and there is a committee of fifty-three compilers who review papers. This committee is an international one, consisting of forty-four Frenchmen, three Belgians, three Englishmen, one Russian, one Swiss, and one American. In addition to reviews of individual papers, some of these compilers have furnished summaries of progress in a subject. With the reviews of any chapter in their hands, the director and secretary have made a summary, exhibiting in a few pages the salient points of progress made during the year in the subject under consideration. This summary precedes the reviews in each chapter, so that the reader may first quickly read the accounts of progress in the different subjects and then look up the more detailed reviews of any particular papers. Finally, there is a "Table analytique" in which are references to about 2500 subjects, groups, and authors; e. g., Heliotropisme, Helix, Helmholtz. Altogether much good judgment has been exercised in the arrangement of the contents of the annual and in making cross references so that the work shall be most serviceable to the student.

As for the reviews themselves, they are in general *reviews* and not *abstracts*, in which respect they quite throw in the shade the contents of the usual "Berichte." Most of them are, of course, less than a page long but important works command much more space. Thus the review of Roux's "Gesammelte Abhandlungen" occupies 13 pages; of Tornier's "Entstehung der Gelenkformen" 7½ pages: of Verworn's

"Allgemeine Physiologie" 10 pages; of Lloyd Morgan's "Definitions of Instinct" 7½ pages (complete translation); of Baldwin's "Mental Development" 8 pages; of Coutagne's "Polymorphisme des Mollusques" (by the author) 6 pages. Many of the reviews are accompanied by valuable critical comments and some of them are illustrated by simple figures.

The summaries of progress and comprehensive reviews are very valuable. Some of these are: Influence of stock on graft, by Daniel; Experimental data upon functional correlation in animals, by Gley; On polyzoism and on the integrating organologic unity in Vertebrates, by Durrand; The defences of the organism in the presence of virus (33 pages), by Charrin; The soluable ferments, by Bourquelot; Comparative study of microbic toxines and of venin, by Phisalix; The modern conception of the structure of the nervous system (25 pages, 7 figures) by Mlle. Szczawinska; Modern psychology and its recent progress (28 pages), by Binet; Note on the theory of plasomes, by Wiesner, with response by Delage; On the phenomena of reproduction, by Hartog. These summaries touch a large proportion of the biological subjects whose advance characterized the year 1895.

Without going at all into the subject matter of this number, which will be considered elsewhere, this much may be said: The appearance of *L'Année biologique* with its classification, analysis, and synthesis of a vast array of facts, many of which find elsewhere no reception, is doing an important work in bringing general biology into recognition as a science coördinate with, although overlapping, morphology and physiology.

There is an important omission, it seems to us, in the list of over 500 periodicals consulted by the editors of *L'Année Biologique*. This omission is of a class of journals which are on the borderline of the scientific but yet contain important biological data. To this class belong the journals devoted to agriculture, horticulture, breeding veterinary medicine, surgery and medicine. From such journals Darwin obtained many of his most important facts. We open his "Variation of Animals and Plants" at random and quote some of his references; Gardiner's Chronical, Encyclopedia of Rural Sports, Horticultural Transactions, Journal of Horticulture, Journal of the Roy. Horticult. Soc., British and Foreign Medico-Chirurg. Review, Jour. of Agricult. of Highland Soc., Landwirthschaft. Wochenblatt, Jour. del'Acad. Hort. de Gand. Interspersed with such as these there are, of course, references to the more scientific journals. There is no question, however, but that now, as in Darwin's time, many most valuable data are to be gleaned from such serials as are enumerated above. It would be well if the new annual could undertake this work also.

We welcome the news that America is at last to have a representative Journal of Physiology; and it is especially gratifying that it is to embrace all fields of physiology, including bio-chemistry, physiological morphology and the physiology of invertebrates. The Journal will be edited by a representative Committee of the American Physiological Society, and will be under the immediate charge of Dr. W. T. Porter of the Harvard Medical School. The price has been set at five dollars per volume of about five hundred pages. The editors modestly suggest that not more than one volume a year will be necessary; we, however, confidently expect that in a few years the American Journal of Physiology will be rolling up as many volumes a year as Pflüger's Archiv does. To enable it to do this, however, it will need the subscriptions of all who are interested in its success. The subscriptions may be sent to Dr. Porter.

Prof. Baur's Observations on the Origin of the Galapagos Islands, begun in the August number, will continue in October.

RECENT LITERATURE.

Tarr's Elementary Geology.[1]—A small octavo volume intended by the author as a text-book for use in secondary schools. The main facts of structural and dynamic geology are given in a graphic, concise way that will best impress a young student. Stratigraphic geology is somewhat curtailed in treatment in accordance with the author's views as to the need of the average high school student. We notice in the time-scale that Pleistocene is adopted instead of the older Quaternary and Eocene and Neocene used in place of Tertiary.

The illustrations are numerous, many of them being original. They comprise 25 page plates and 485 reproductions from photographs and diagrams in the text.

Mr. Tarr is to be congratulated upon having chosen judiciously from a mass of material the facts necessary to a good foundation for further study of the history of the earth.

U. S. Commission of Fish and Fisheries.[2]—The report of the Commissioner for the year ending June, 1895, comprises reports on the propagation and distribution of food fishes, by W. C. DeRavenal; on food fishes and fishing grounds, by Richard Rathbun; and on the statistics and methods of the fisheries, by H. M. Smith. In addition there are several papers based on the work of the Commission. These comprise the investigations of the steamer Albatross by Lieut. Com. F. J. Drake; Biscayne Bay as a Marine Hatching and Experiment Station, by H. M. Smith; Transplanting of Eastern Oysters to Willapa Bay, Washington, by C. H. Townsend; Description of a New Shad from Alabama, by B. W. Evermann; and a Check-List of the Fishes and Fossil-like Vertebrates of North and Middle America, by D. S. Jordan and B. W. Evermann.

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[1] Elementary Geology. By R. S. Tarr. New York, 1897. 8vo, MacMillan & Co., $1.40.

[2] U. S. Commission of Fish and Fisheries, Pt. XXI. Report of the Commissioner for the year ending June 30, 1895. Washington, 1896.

These various papers demonstrate the importance of the work carried on by the Commission, both from an economic and scientific standpoint. From year to year this organization accumulates and records an immense amount of information that stands for all time as reliable data.

Hand-book of British Birds.[3]—This book comprises an enumeration of every species of birds on the British list, with descriptions of nearly all the species named. Records of the rarer forms have been carefully collected, and a tolerably complete life-history of the common species is given. In the nomenclature the author adopts the American system of trinominals, as he sees no other way of allowing a name to a recognized race without giving it the rank of a species. In all, Mr. Swann recognizes 381 species which are referred to 208 genera. The volume constitutes a handy reference book for the student afield.

A List of Periodicals.—Nearly twenty years ago a small pamphlet was published containing a list of scientific periodicals, transactions of learned societies, etc. accessible in the libraries in the vicinity of Boston. The list became antiquated and has long been out of print. In the present year the Boston Public Library has taken up the same idea and the result is a list of periodicals, etc.,[4] which must be of the greatest value to students in any line as it is a catalogue of the largest collection of serial publications accessible in any locality in America. Unlike its modest predecessor, it is not limited to science but embraces the periodicals of all kinds contained in thirty-six libraries in Boston,

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[3] A Concise Handbook of British Birds. By H. Kirke Swann. London, 1896.

[4] A list of periodicals, newspapers, transactions, and other serial publications currently received in the principal libraries of Boston and vicinity. Boston: The Trustees of the Public Library, 1897, pp. 143.

Cambridge, Somerville and Jamaica Plain. The titles are given and with each title are index letters indicating in which library the periodical may be found. Numerous cross references add to the value of the list, which, while intended for students in the neighborhood of Boston, will prove of great value to investigators in any locality.

In this connection we might call attention to the fact that the Boston Society of Natural History published,[5] a few years ago a list ot serial publications currently received in its library and that it has now issued a supplement to this list as well as a list of discontinued serial publications in its library[6] of about four hundred titles.

General Notes.

PETROGRAPHY.[1]

Igneous Rocks of Trans-Pecos, Texas.—The igneous rocks intrusive in the sedimentary series of Trans-Pecos, Texas, according to Osaun[2] comprise plutonic, dyke and effusive types belonging to a series of rocks rich in soda. They are characterized by the possession of alkaline pyroxenes and amphiboles (aegirine, aegirine-augite and arfvedsonite), of microperthitic intergrowths of orthoclase and albite, and of riebeckite, lavenite and a mineral resembling ainigmatite. In the Apache Mountains the plutonic rocks are accompanied by dykes of paisanite, tinguaite and bostonite. The intrusive phases of this series are eleolite-syenites, normal and porphyritic varieties, aegirine-syenites and normal syenites. The dyke rocks identified are tinguaite, bostonite, paisanite, (see analysis I, below), and the effusives are rhyolites and phonolites. Several of these rocks have been noticed in the reports of the Texas Geological Survey.[3] The paisanite is regarded as a quartz bearing member of the gromdite-tinguaite series as found in the neighborhood of Christiana. The Texan phonolite is of such a peculiar type that it has been designated as apachite. It occurs in two laccolites and in sheet form. The rock is composed of phenocrysts of sanidine and nepheline, the latter often surrounded by rims of amphiboloids in a

[5] Proceedings of the Boston Society of Natural History. Vol. XXVI, 1894.

[6] Proceedings, vol. XXVIII, 1897.

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Me.

[2] Min. u. Petrog. Mitth., XV, p. 394.

[3] Cf. American Naturalist, 1894, p. 514.

groundmass consisting of diopside-malacolite, augite, aegirin-augite and aegirine, amphiboles, related to arvfedsonite and katoforite, ainigmatite, several generations of feldspar and a small quantity of glass. Apachite differs from normal phonolite in the great abundance of ainigmite and the members of the hornblende group, and in the younger age of the latter with respect to the pyroxene. It contains also great quantities of microperthitic feldspars.

An analysis of the rhyolite of Fort Davis is given under II.

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	K_2O	H_2O	TiO_2	P_2O_5	Total
I.	73.35	14.38	1.96	.34	.09	.26	4.33	5.66				= 100.37
II.	71.10	11 39	5.33		1.54	.08	3.95	6.37	.44	.57	.05	= 100.82

Italian Petrographical Studies.—In a recent paper, Washington[4] summarizes the results of his work on the Bolsena-Vesuvius volcanics, and presents some views on the classification of leucite rocks and of those intermediate in composition between trachytes and basalts. In accordance with the nature of their feldspathic constituent, he would divide trachyte-basalts into a trachyte series, embracing those rocks containing only an alkali-feldspar, a trachy-andesite series, including those containing an alkali-feldspar and an acid plagioclase, a trachy-dolerite series, composed largely of an alkali feldspar and a basic plagioclase, an andesite series—acid plagioclase (andesine-oligoclase) rock, and a basalt series, a basic plagioclase series. Among the trachy-andesites the author would place the Iceland rhyolites, vulcanite, dornite, the Euganean and the basic auvergne trachytes, and among the trachy-dolerite series the toscanites, the vulsinites and the ciminites described by himself, and the banakites, shoshonites and absarokites of the western United States. The leucite rocks met with in the Italian volcanoes are thought to be best classified as leucitites, leucite-basalts, leucite-basanites, leucite-tephrites, leucite-trachytes and leucite-phonolites. Upon comparing their analyses the silica contents of these rocks are discovered to cluster around 49 per cent and 56 per cent, a fact which is regarded as not due to accident. The original magma, of which the Italian volcanoes are the differentiated products, is thought to have had a composition approximating the following: SiO_2=57–58; Al_2O_3=17–18; FeO (Fe_2O_3)=6–7; MgO=2–3; CaO =5–6.5; Na_2O=2.25; K_2O=7–8; H_2O=1–1.5 per cent.

Rock Differentiation.—Iddings[5] devotes a few pages to his theory of rock differentiation as applied to the Electric Peak volcanics, reply-ing to criticisms recently made by Brögger. This author declares that the order of primary differentiation can be learned only from a study of large bodies of plutonic rocks, and that conclusions with respect to this subject based on the study of extensive masses are not reliable. He further states that the order of succession in eruptions is from basic to acid magmas, often ending with basic ones, and not from intermediate magmas to greater and greater extremes. After describing at some length the general distribution of the igneous rocks in Idaho, Montana and Wyoming, and comparing the great volume of the effusive rocks erupted in this volcanic district with the relatively small (though actually great) volume of intrusive rocks, Iddings states that he cannot but believe that the differentiation which gave rise to the former must have been more fundamental than that which gave rise to the intrusive rocks, and hence its products reveal the true character of the primary differentiated of a molten magma at considerable depths beneath the surface. Moreover, the sequence of the intrusive rocks is practically the same as that of the effusive in the Electric Peak district, viz., from intermediate through acid to basic rocks.

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[4] Jour. of Geology, Vol. V, p. 349.

[5] Quart. Jour. Geol. Soc., Vol. LII, 1896, p. 606.

Granites of Pyramid Peak District, California.—Lindgrew[6] describes the rocks of the Pyramid Peak district in the Sierra Nevadas as consisting of an older series of slates, tuffs, schists, porphyrites and granitic rocks overlain by Tertiary andesites, rhyolites and basalts. The granites are intrusive in the old series, metamorphosing the latter for a distance of several miles from their contacts with them. The clay slates in their most metamorphosed forms are micaceous schists or gneisses. At a greater distance from the granite they are 'knoten schiefer,' often carrying andalusite. The granitic rocks include aplites, granites, granite-diorites, diorites and gabbro. The highest ridges of the district are composed of granitite. Granodiorite is the predominant rock. It consists of quartz, an acid plagioclase, biotite, hornblende and a little sphene and magnetite. The rock is intermediate in composition between quartz-mica-diorite and Brögger's quartz-monzonite. While not always easily distinguished from the former rock, the author would restrict the name granodiorite to rocks containing 59 per cent.–69 per cent. SiO_2, 14 per cent.–17 per cent. Al_2O_3, 1½ per cent.–2¼ per cent. Fe_2O_3, 1½ per cent.–4¼ per cent. FeO, 3 per cent.–6½ per cent. CaO, 1 per cent.–2½ per cent. MgO, 1 per cent.–3¾ per cent. K_2O and 2½ per cent.–4½ per cent. Na_2O. Analyses of the granite (I) and of the grano-diorite (II) follow:

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[6] Amer. Jour. Sci., Vol. III, 1897, p. 301.

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	H_2O at 100%	H_2O at 100%	$+P_2O_5$	
I.	77.68	.14	11.81	.72	.51	.72	.18	5.00	2.96	.04	.27	.10	=100.13
II.	67.45	.58	15.51	1.76	2.21	3.60	1.10	3.66	3.47	.14	.63	.12	=100.25

Pegmatite.—As the conclusion of a very thorough discussion of the origin of pegmatite Crosby[7] and Fuller declare that this rock is the product of crystallization from an igneous magma saturated with water—an igneo-aqueous solution. The authors, moreover, believe that no sharp line of distinction can be drawn between dykes and veins and, therefore, that veins are clearly entitled to some degree of recognition in the lithological classification.

BOTANY.[8]

Gray's Synoptical Flora.[9]—On the tenth of June, just twenty months after Fascicle I, Dr. Robinson brought out Fascicle II of the new edition of Gray's Synoptical Flora of North America. It includes the "orders" Caryophyllaceæ (by B. L. Robinson), Ficoideæ (by B. L. Robinson), Portulacaceæ, Tamariscineæ (by B. L. Robinson), Elatinaceæ, Hypericaceæ (by J. M. Coulter), Ternstroemiaceæ, Cheiranthodendreæ, Malvaceæ, Sterculiaceæ, Tiliaceæ, Linaceæ (by W. Trelease), Malpighiaceæ, Zygophyllaceæ, Geraniaceæ (by W. Trelease), Rutaceæ, Simarubaceæ, Burseraceæ, Anacardiaceæ, Meliaceæ, Aquifoliaceæ (by W. Trelease), Cyrillaceæ, Olacinaceæ, Celastraceæ (by W. Trelease), Rhamnaceæ (by W. Trelease), Vitaceæ (by L. H. Bailey), Sapindaceæ (by B. L. Robinson), and Polygalaceæ (by B. L. Robinson). It is thus seen that of these twenty-eight families, twelve were prepared by other hands than Dr. Gray's, and in several of the remaining sixteen more or less extensive revisions were made by Dr. Robinson.

We note with interest the much freer acceptance of disputed names than in the previous fascicle; thus we have *Impatiens aurea* Mahl. and *I. biflora* Walt. (instead of *I. pallida* Nutt. and *I. fulva* Nutt.); *Vitis vulpina* L. (instead of *V. riparia* Mx.); *Vitis rotundifolia* Mx. (instead of *V. vulpina* of American authors); *Acer saccharinum* L. (instead of *A. dasycarpum* Ehrh.); *Acer saccharum* Marsh (instead of *A. sacchari-*

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[7] Technology Quarterly, IX, 1896, p. 326.

[8] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

[9] *Synoptical Flora of North America*, Vol. I, Pt. I, Fascicle II. Polypetalæ from the Caryophyllaceæ to the Polygalaceæ, by Asa Gray M. D., continued and edited by Benjamin Lincoln Robinson, Ph. D., pp. 207 to 506. Issued June 10, 1897. New York, American Book Company.

num Wang.); and *Acer negundo* L. (instead of *Negundo aceroides* Moench.). A title page and an excellent index to Fascicles I and II, which are to be bound together, close this interesting part. The third Fascicle is now in preparation by Dr. Robinson.

—Charles E. Bessey.

Britton and Brown's Illustrated Flora.[10]—Last August the first copies of Vol. I of this work were distributed, and about the middle of June of the present year copies of Vol. II reached the botanists of the country. The good opinion of the work formed from an examination of the first volume is confirmed by even a glance through the second. The outline figures continue to be most useful, and while not always absolutely distinctive, they are often fully as much so as the actual specimens. We have now and then seen criticisms of these figures by those who forget that it is impossible to show striking differences between species which nature has not separated widely, especially when the figures must be made as small as they are in this work. We feel that the artists who made these illustrations are deserving of much praise for the success with which they have done their work.

As to the text there remains little to be said beyond what was said in our notice of Vol. I (Naturalist, October, 1896). The selection of type is so good that the eye catches without loss of time the items sought. The consistent use of the modern rules of nomenclature, readily familiarizes us with the comparatively small number of new names made many by the "reform movement."

The families of most interest in this volume are Ranunculaceæ, Crucifereæ, Saxifragaceæ, Rosaceæ, Pomaceæ, Drupaceæ, Mimosaceæ, Cæsalpiniaceæ, Papilionaceæ, Euphorbiaceæ, Violaceæ, Cactaceæ, Onagraceæ, Umbelliferæ, Ericaceæ, Vacciniaceæ, Oleaceae and Gentianaceæ.

We notice that a list of metric units and equivalents is given at the end of the table of contents. Of what service it can be in a volume in which no metric measurements are used is difficult to make out. It only serves to call attention to the anachronism of ancient units in a modern text. The concluding volume will be looked for with great interest by botanists everywhere.—Charles E. Bessey.

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[10] *An Illustrated Flora of the Northern United States, Canada and the British Possessions*, by Nathaniel Lord Britton, Ph. D., and Hon. Addison Brown. In three volumes. Vol. II, Portulacaceæ to Menyanthaceæ. New York, Charles Scribner's Sons. 1897.

ZOOLOGY.

Fauna of Aldabra.—The following information concerning the natural history of the island of Aldabra has been recently published by Dr. W. L. Abbott. The most remarkable inhabitant of Aldabra is the gigantic land tortoise, similar to those of the Galapagos group. They were formerly very abundant, but being easily caught and in great demand for their flesh, their numbers have been greatly diminished by the whalers and fisherman. Their greatest enemy is the common rat, which swarms upon Aldabra and eats the young as soon as they are hatched.

The only other land reptiles upon Aldabra are a small lizard (*Ablepharus poecilopleurus*) and two geckos (*Hemidactylus mabronia* and *Phelsuma abbottii*).

Turtles are plentiful. Many thousands annually ascend the sandy beaches to deposit their eggs. Tortoise-shell was formerly gathered in large quantities, but this fishery has been overworked and large "carré" are now scarce.

Mammals are represented by a large fruit bat (*Pteropus aldabrensis* True) and two smaller bats. Rats (*Mus decumanus*) probably from wrecked vessels, swarm everywhere, and are very destructive. Cats, probably from the same source, are common upod Grande Terre, where they have completely exterminated the flightless rail.

Land birds are represented by fourteen resident and six accidental visiting species.

The most interesting of birds is the curious flightless rail (*Rougetius aldabranus* Ridgway), the sole survivor of the numerous flightless birds that inhabit the Mascarine Islands at the time of their discovery. The present species is in great danger of being exterminated by the cat, which sooner or later will overrun the smaller islands, as it has done Grande Terre. The other land birds are apparently identified with those of Madagascar.

Insects are not numerous either in species or individuals. Six or seven butterflies, a few moths, a dragon fly, a few beetles, some flies and bees are found. Mosquitoes abound. (Proceeds. U. S. Natl. Mus. XVI, 1894.)

A List of the Birds of the Vicinity of West Chester, Chester Co., Pennsylvania.—(*Continued from page 628.*)—

72. *Ammodramus savanarrum passerinus* (Wils.), Grasshopper Spar-

row. Rather infrequent summer resident, during some years not seen at all.

73. *Zonotrichia leucophrys* (Forst.), White-crowned Sparrow. Very infrequent, if not rare, migrant in the spring and fall. I shot a bird of the year on Oct. 18, 1890, and another Oct. 6, 1888 ; and during one spring I saw an adult male.

74. *Z. albicollis* (Gmel.), White-throated Sparrow. Abundant migrant in the spring and fall, but it does not appear to remain through the winter. (Dates of spring occurrences : April 25, 1886 ; April 28 to May 10, 1887 ; May 9–19, 1888 ; March 29, 1889 ; April 12, 1890 ; April 18, 1891. Latest fall occurrences : Nov. 6, 1886 ; Oct. 27, 1887 ; Dec. 31, 1888 ; Nov. 1, 1890).

75. *Spizella monticola* (Gmel.), Tree Sparrow. Abundant winter resident. (Earliest arrival noted : Oct, 12, 1889 ; latest spring date : April 2, 1895).

76. *S. socialis* (Wils.), Chipping Sparrow. Abundant summer resident. (Earliest spring arrivals. Apr. 8, 1887 ; April 1, 1888 ; April 14, 1889. Bulk arrived : April 11, 1887).

77. *S. pusilla* (Wils.), Field Sparrow. Summer resident, perhaps not quite as abundant as the preceding. (Bulk arrived : March 10, 1888 ; April 19, 1890).

78. *Junco hyemalis* (Linn.), Slate-colored Junco. Abundant winter resident. (Earliest fall occurrence : Oct. 1, 1886. Latest spring occurrences : April 6, 1895 ; June 7, 1890).

79. *Melospiza fasciata* (Gmel.), Song Sparrow. Resident, but in cold winters many migrate, at least from the higher, more exposed portions of the country. This is apparently our most abundant native bird.

80. *M. georgiana* (Lath.), Swamp Sparrow. Common migrant in the spring and fall. (Spring occurrence : March 23, 1886 ; April 21, 1888 ; April 13 to May 9, 1891 ; May 9, 1897. Dates of fall occurrences ; Oct. 6, 1888 ; Oct. 5–18, 1890).

81. *Passerella iliaca* (Merr.), Fox Sparrow. Common migrant in the spring and fall. (Spring occurrences : March 17, 1885 ; March 16, 1886 ; Feb. 22 to March 21, 1888 ; March 15–28, 1889 ; March 2–9, 1890 ; March 10 to April 13, 1891 ; March 10, 1895. Have found it in the fall from the 1st to the 15th of November).

82. *Pipilo erythrophthalmus* (Linn.), Towhee. Common summer resident. (Earliest spring arrivals : April 1, 1886 ; April 27, 1887 ; April 20, 1889 ; April 18, 1891. Bulk arrived : May 1, 1887 ; May 6, 1888).

83. *Cardinalis cardinalis* (Linn.), Cardinal Grosbeak. Rather infrequent ; I have observed it only in the spring and fall. It is quite

probable that it breeds in this vicinity, but I have never seen it in summer.

84. *Zamelodia ludoviciana* (Linn.), Rose-breasted Grosbeak. Infrequent migrant. I received, from a friend, two specimens in the flesh, Oct. 1, 1887, and I shot another May 5, 1888.

85. *Passerina cyanea* (Linn.), Indigo Bunting. Common summer resident. (Earliest spring occurrences noted: May 4, 1887; May 8, 1891; May 16, 1897).

86. *Piranga erythromelas* (Vieill.) Scarlet Tanager. Infrequent summer resident, in thick woods. (Earliest spring date, May 6, 1887).

87. *Progne subis* (Linn.), Purple Martin. Tolerably common summer resident. (Arrives in the spring about the first half of April).

87. *Petrocheliodon lunifrons* (Say), Cliff Swallow. Infrequent summer resident, more abundant during the migrations.

89. *Chelidon erythrogaster* (Bodd.), Barn Swallow. Abundant summer resident. (Earliest spring arrivals: April 21, 1886; April 12, 1887; April 7, 1888; April 21, 1889; April 17, 1891. Bulk arrived: April 28, 1886; May 2, 1887. All depart in the fall at or before the first week in October).

90. *Tachycineta bicolor* (Vieill.), Tree Swallow. I shot two specimens and saw two others on April 25, 1891, by the Brandywine, and saw another three days later in West Goshen. It is strange that it should be so infrequent here, while it is so abundant during the migrations in other portions of eastern Pennsylvania.

91. *Clivicola riparia* (Linn.), Bank Swallow. Infrequent migrant.

92. *Stelgidopteryx serripennis* (Aud.), Rough-winged Swallow. Common summer resident along the Brandywine.

93. *Ampelis cedrorum* (Vieill.), Cedar Waxwing. Common migrant in the spring and fall; a few breed here. I have seen it only once in the winter, Jan. 13, 1886. (Earliest spring arrivals: March 14, 1889; March 1, 1890).

94. *Lanius borealis* (Vieill.), Northern Shrike. A rather infrequent and irregular winter visitant, from November until the middle of March, but in 1890 I saw one as late as April 6th.

95. *L. ludovicianus* (Linn.), Loggerhead Shrike. I shot two adult males, March 28, 1895, in West Goshen (these are now in the collection of the Acad. Nat. Sci. Philada). This is the only published occurrence of this species in Chester Co., and the second, of late years, for eastern Pennsylvania.

96. *Vireo olivaceus* (Linn.), Red-eyed Vireo. Abundant summer resident, more numerous than any other species of the family. (Earliest

spring arrivals: May 9, 1887; May 10, 1888; May 4, 1891. Bulk arrived: May 13, 1887; May 12, 1888).

97. *V. gilvus* (Vieill.), Warbling Vireo. Common summer resident.

98. *V. solitarius* (Wils.), Blue-headed Vireo. Tolerably common migrant in the spring and fall. (Dates of spring occurrences: April 28, 1888; April 20, 1889; May 10, 1890; April 22, 1891. Fall occurrence: Sept. 23, 1890).

99. *V. noveboracensis* (Gmel.), White-eyed Vireo. Rather infrequent summer resident.

100. *Mniotilta varia* (Linn.), Black-and-White Warbler. Abundant migrant in the spring and fall. I have never found it in the summer, though several nests have been taken in this county. (Spring occurrences: May 7, 1887; May 3–17, 1890; April 25, 1891; May 2, 1897. Fall occurrences: Aug. 24 to Sept. 9, 1887; Aug. 21–28, 1888; Sept 28, 1889; Sept. 6 to Nov. 29, 1890).

101. *Helmitherus vermivorus* (Gmel.), Worm-eating Warbler. Infrequent summer resident; it is no more abundant during the migrations. (Arrives about the second week in May).

102. *Helminthophila pinus* (Linn.), Blue-winged Warbler. I have seen this species only once, when I secured a specimen in West Goshen, May 17, 1890. It must be considered rare in this immediate neighborhood. Subsequently (May 9, 1897) I saw another.

103. *H. chrysoptera* (Linn.), Golden-winged Warbler. One male, May 5, 1897).

104. *H. ruficapilla* (Wils.), Nashville Warbler. A not infrequent migrant in May and September.

105. *Compsothlypis americana* (Dinn.). Parula Warbler. Abundant migrant. (Spring occurrences: May 6–10, 1888, May 3, 1890; May 4, 1891. Fall occurrences: Sept. 18–20, 1889; Sept. 23, 1890).

(*To be continued.*)

ENTOMOLOGY.[1]

Protective Value of Motion.—Mr. F. M. Webster in an address delivered before the Ohio Academy of Science and afterwards published in the Journal of the New York Entomological Society[2] makes some interesting remarks on the protective value of action, volitional or otherwise, in "protective mimicry." After citing a number of remarkable cases more or less well known he remarks, "Now in all these phenomena we have form and color supplemented by action, the object of all of which taken together is the protection of life. * * * * It was Mr. Bates who wrote in his "Naturalist on the Amazon," that "on the wing of the butterfly is written, as on a tablet, the story of the modification of the species, so truly do all the changes register themselves thereon," and it seems to me that in the brains of so-called "mimicing" species of insects, we might, if we could but understand the full significance ot the brain cells, read therein the records of the development of a dim, obscure consciousness, a volition and an intelligence that has kept pace in the requirements of these organizations in protecting their lives and perpetuating their race. Man himself comes into the world, little less than a mere automaton but with an inherited basis for future developments of an individual consciousness, he begins his education with the alphabet but does not transmit even a knowledge of this alphabet to his children, who must begin precisely where he himself began. But there has descended to his children that which will enable them to master the alphabet with more aptitude and less difficulty. Now if we descend the line of animal life until we reach these insects whose movements go far toward perfecting the protection afforded by their form, color and coloration, may we not expect to find the foundation for a "species consciousness" that will enable their possessors to protect their lives from enemies of long standing, and gradually, though perhaps very slowly, adapt themselves to shunning the attacks of more recent foes. Or, to put it in other words, with a protective appearance, will there not go either a consciousness of that appearance or an inherited foundation for such a consciousness that will better enable an insect to apply its protective inheritance, and in the use of all these as a means of perpetuating its kind, follow strictly in the line of all other animal life?"

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[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

[2] Journal of New York Ent. Soc., V. 67–77.

Among the most wonderful cases of "protective resemblance" noted was that of the moth *Alaria florida* "which conceals itself during the day in the withering blossoms of the Evening Primrose *Cenothera biennis*. The inner two-thirds of the wings of the moth are bright pink while the outer third, hind wings and abdomen are pale yellow. The moth enters the flower before day with its body resting on the style, the four parted stigma projecting beyond the tip of the abdomen, appearing like a part thereof, and when the sun appears the two petals that were above the moth soon wilt and fall down over the roof like wings, concealing the rose colored portion and leaving the yellow part exposed as a part of the blossom and so effectually is the moth concealed in this way during the day that only a trained eye can detect its presence, and then only with extreme difficulty." The moth mentioned is very common in central New Hampshire though it appears to be either very rare or unknown nearer the sea and I have observed hundreds of specimens in the position described. The deception is certainly well carried out though not in every case so fully as described by Mr. Webster but the larva is even more closely concealed.

I had read that it was to be found feeding on the seed pods of the Evening Primrose and had several times looked for it in vain until one day I discovered a specimen in the act of backing out of the hole which they excavate in the pod, by gnawing a hole in the side and then eating the more juicy seeds. I broke off the whole stalk and was carrying it home when I noticed that there was a second caterpillar resting between the pods and resembling them so wonderfully both in shape and size as to escape my notice. I then began to examine the head more closely and to my astonishment I found seven others resting in a similar manner. I thought I had seen them all then, but on looking in the breeding cage in which I had placed them, two or three days after, I found the stalk so wilted as to be unpalatable to the caterpillars and no less than eleven were wandering around the sides of the cage. The other two were doubtless in the same position as those seen but were overlooked even in a close inspection. There is the possibility that they may have been in one of the hollowed pods but it is not at all probable as they would have had much difficulty in completely entering one.—W. F. F.

Ambrosia Beetles.—In the year book of the Department of Agriculture for 1896, Mr. Henry G. Hubbard has contributed an article of more than usual interest to the general reader on the habits of the "Ambrosia beetles." These beetles which are quite small and resemble their relatives the bark boring Scolitidæ, differ from all other known wood boring insects by not feeding on the wood itself but on a fungus which grows on the interior of their burrows.

Their galleries may easily be known from wood feeding species by being clear from bits of wood or other refuse and being black on the inside as though burnt with a hot wire. These galleries are usually excavated by the female but in some instances she is assisted later by the young larva.

The food fungus, or "ambrosia" does not "make its appearance at random in the galleries of the beetles. Its origin is entirely under the control of the insect. It is started by the mother beetle upon a carefully packed layer or bed of chip, sometimes in the bark but generally at the end of the branch galley in the wood."

In some species the ambrosia is only grown in certain chambers of peculiar construction. In many species it appears to be necessary that the sap of the tree should be in a state of ferment and the beetles will sometimes attack wine and ale casks. "In the care which they give their young and in the methodical and complex provisions which they make for the welfare of the colony, these beetle display the characteristics of true social insects, such as are known among bees, wasps, ants and termites, but which have not hitherto been found to exist among any other representives of the order Coleoptera."

The eggs of some species are laid in clusters of ten or twelve loosely in the galleries, and the young wander freely about feeding on the ambrosia. In other species each larva is contained in a cell of wood the excavation of which is began by the mother but completed by the partly grown larva. In this case they are fed by the mother beetle who keeps the entrance to this cell closed with a plug of ambrosia. The males of some species are small and wingless and fertilization of the female takes place in the burrow. In others the male is large and winged and accompanies the female in her flight to found new colonies. Should the number of beetles in a colony be diminished by accident or disease the food fungus soon chokes up the galleries and remaining inhabitants soon die of suffocation. In the case of the wingless males this would soon take place when abandoned by the females did they not unite in certain galleries and by keeping the fungus cropped, prolong for a time their useless existence.—W. F. F.

The Brown-Tailed Moth.—There has recently been formed in England a "committee for the protection of insects in danger of extermination" and a list of the species which they desire to protect has been published. Among them, are a few species like *Melitœa athalia* or *M. cinxia* or *Lycœna arion* which are perfectly innoxious and confined to a few isolated localities, for which it would not be unreasonable on the part of the true butterfly lovers to ask for protection against "pot hunters" or those who collect them merely for their value for sale or exchange. But there are others on the list and among them the "brown tailed moth" (*Euproctis chrysorrhœa*) which will probably be included in the next list of American lepidoptera.

In a late bulletin Prof. C. H. Fernald has given the history of this species in America with a short history of its life and descriptions of its stages. The moth itself belongs to the same family as the Gypsy moth, Tussock moth and several other less known species. They are pure white with a silky lustre and a reddish-brown tuft at the end of the abdomen from which arises the common name. The young larva pass the winter in a nest made by drawing together a few terminal leaves of a twig and lining and surrounding them with a mass of silken threads. It is not known exactly when or how it was introduced into America but it has been noticeably injurious for at least four years and it is possible that it may have been imported with some foreign stock. It is at present confined to a small area in the vicinity of Boston.—W. F. F.

EMBRYOLOGY.[1]

Spinning in Serpula Eggs.—In a paper[2] published in the Journal of Morphology, G. F. Andrews described remarkable and hitherto unrecorded phenomena in the eggs and larvæ of star-fish and sea-urchins and designated them filose protoplastic or "spinning" activities.

These "spinning" phenomena may be described as the formation of filaments extending out from the surface of the egg or cell and either straight, curved or bent; either separate or united to others; either simple or variously branched; attached at the base, and either free at the tip or attached there also—to the egg membrane, to other filaments or to the surface of some other cell. What makes these threads recognizable as living protoplasm is chiefly the character of their activities. They are *spun* out from the living egg or cell as are the filose pseudopodia of such creatures as Gromia, or as some of the pseudopodia of the leucocytes of certain Invertebrates. The processes are seen to grow longer or shorter, to branch, to join onto and fuse with others; they grow thicker or thinner, and often show nodular enlargements that pass along as in currents of living protoplasm.

Such filose spinnings connect the egg with its membrane, the cleaving cells with one another, and the polar bodies with adjacent cells or with the unsegmented egg. They traverse the cleavage cavity and put cells of ectoderm, entoderm and mesoderm into communication with cells of the same and of other germ layers.

Such intercellular connections are temporary, made and remade; they spin out as a cell is separating from its fellow in division and are not seen when the cells are closely pressed together.

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[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

[2] See the AMERICAN NATURALIST. No. 363, March, 1897, page 242.

Having been shown these phenomena both in living and in preserved echinoderm eggs I was able to find them again in the common Annelid, Serpula;—though as yet by no means as clearly and extensively as in the more thoroughly studied and favorable star-fish material.

The egg of Serpula is much less favorable than that of the star-fish, as far as the seeing of spinning phenomena is concerned, since it has a thick, very highly refracting membrane that makes it difficult to see fine structures within it, and since also the cells are so closely crowded together and against the membrane (which remains as the larval cuticle) that there are few free spaces which could be traversed by spin threads.

Yet some filaments can be seen passing out from the egg, or cells, to the membrane. As yet I have not seen spinning filaments connect one cell with another though there was evidence that such probably exist and are to be seen with good light and favorable point of view.

When the polar bodies have been formed, the membrane is raised up from the egg sufficiently to leave a space all about the polar bodies. Though at first no processes are seen, they gradually form and extend out from the egg till they cross the space and become attached to the membrane. These processes are unmistakably the same as the spinnings of the star-fish egg. They are of different lengths and thicknesses and arise from the surface of the egg all around the polar bodies. The polar bodies were not seen to spin.

In cases where the egg-membrane is raised up locally at the end opposite to the polar bodies, spin-threads were also seen passing from this side of the egg to the raised membrane.

In abnormal individuals where the membrane is widely separated from the egg, long and very numerous and distinct threads were seen radiating out from the entire surface of the egg to the membrane. As in the star-fish there is a marked difference between the spinning of normal and abnormal eggs.

When the egg has divided into two cells and these are rounding off at the edges preparatory to the next division, spin processes are seen passing off from each cell to the membrane, both at the polar body pole and at the opposite end.

Here I first observed the branching of filaments, so characteristic in the star-fish. One common trunk arising from a cell presents a number of long branches that pass in various planes out to the membrane.

In later stages when eight or more cells are present, processes were seen, both in profile and in surface view, passing out from various cells to the membrane.

In the gastrula stage when the equatorial band of cilia is formed and the cleavage cavity nearly closed up by the elongated entoderm cells, spin processes were seen at the end opposite to the area of invagination, passing from the ectoderm cells to the membrane where it was slightly raised away from the ectoderm. Here also some movement and change of form was seen in a process, though not satisfactorily. Within the cleavage cavity a moving, pseudopodium-like process appeared to extend out from the entoderm toward the ectoderm, but it could not be seen clearly.

Some of these processes in Serpula, less difficult to see than the finest, presented enlargements, suggesting the probability of slow flowing of material along the process. The increase in number and length of filaments from a definite area under observation for a few minutes showed that they were gradually formed, and from the egg outwards.

Owing to poor light no higher than 8 eye-piece could be used with 2 mm. objective, so that it is probable many phenomena escaped observation.

The occurrence of such filose activity of the surface of the eggs of an animal so widely separated from the echinoderms supports the idea that such phenomena are universally properties of protoplasm,—an hypothesis put forth in a recent work[3] and based not only upon egg, and other, external spinnings, but upon numerous internal protoplasmic phenomena of the same nature, such as spinnings into alveoli of Bütschli's structure in both fluid areas and contractile structures, and contraction and strial displacements of the substance.

E. A. ANDREWS.

PSYCHOLOGY.[1]

Some Experiments on the Tactual Threshold for the Perception of Two Points.[2]—The term "space-threshold" was applied by Fechner to the distance which two small points must be apart in order to be perceived as two. Weber had already devoted much time to the determination of this distance for different spots on the skin, for he found that the two points must be farther apart, to be felt as two, on some spots than on others. On the bicepts muscle of the upper arm, it is 66 mm.; on the volar side of the forearm, 40 mm.; on the tips of the index fingers less than 2 mm., etc. Many questions arose and many investigators have busied themselves with them; but a number of questions in this field, in spite of the numerous books and articles on the subject, have in some cases received no attention, and in others have not been answered. With the exception of one article, the question as to the threshold for the perception of spatial difference in the case of two *successive* stimuli has never been raised. In experiments with two simultaneously stimulating points, it has long been known that the distance which two points must be apart in order to be perceived as two at any one spot of skin can be reduced in a very marked degree by practice. It was further noticed by Volkmann and Fechner that when this distance is reduced by practice on any one spot, the threshold for the symmetrically opposite spot on the other side of the body undergoes a like reduction without being practiced. These investigators gave a purely physiological explanation of the phenomenon, viz., that the centre in which the two sets of fibres (those from the symmetrical spots) meet is the seat of the change which causes the reduction. Their experiment was not, however, so planned as to test the question whether a similar reduction of this threshold occurs over the entire body.

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[3] The Living Substance as Such and as Organism. G. F. Andrews. Gnin & Co. Boston. August, 1897.

[1] Edited by Howard C. Warren, Princeton University, Princeton, N. J.

[2] The first group of experiments described here were reported in the *Philosophische Studien,* 1897, XIII, 163-222, reprinted in *Princeton Contributions to Psychology,* II, 1-60. The second group, viz., those with successive stimuli, will appear in an early number of the *Psychological Review.*

Our first duty was to undertake a series of such experiments. These were carried out by the writer at the Leipzig Psychological Laboratory. As a result, it proved to be true that the same reduction does occur over the entire body whenever it occurs on any part of the body, and this result points directly to the inference that the whole phenomenon demands a central explanation based upon central psychic processes. But in connection with these experiments several singular phenomena came to light. (1) Not all subjects showed the reduction of the threshold by practice: in fact, it occured only in the cases of those who knew beforehand what the problem was and what results had been hitherto reached by others. In cases where the subject did not know these facts and did not surmise them from the nature of the experiments, no reduction whatever occurred. (2) In all cases where the reduction occurred, there appeared as one result of the practice an increase in the frequency of the illusion called by the Germans *Vexirfehler*, i. e., where the subject senses two points when touched by but one. In cases in which the series began without these illusions, as with some subjects, the illusion developed after some practice in the experiments. This illusion sometimes becomes so frequent that no thresholds can be determined; the subject answers, in response to all stimuli, whether of one or of two points, "two points." (3) A long series of experiments showed that this illusion is, for the most part, a result of suggestion of some kind; a suggestion which the subject gets either from the operator, from the nature of the experiments, or by auto-suggestion. It was found that the frequency of the illusion, and even its occurrence at all, could be influenced to a marked degree by suggestion. In some cases the illusion could be prevented by the subject's discovering the suggestive influence and freeing himself from it. (4) Subjects were found who, to start with, gave constant thresholds as long as nothing was suggested to them in regard to the object and method of the experiments, but by a suggestion from the operator, they were led to show a very rapid reduction of the threshold. Afterward, by freeing themselves from the influence of the suggestion, they returned, in some cases, to the old constant threshold, freeing themselves at the same time from the illusions which had developed as one result of the suggestion.

All of these facts go to indicate that both the reduction of the threshold by practice and the illusion of two points are the results of suggestion in some form. In every instance of the perception of space relations by touch, there seems to be involved a process of assimilation in which a visual or motor image is the assimilating, and the tactual sensations the assimilated, elements. In ordinary life, we test continually our tactual sensations by visual images, turning the eyes to look at the spot touched. In these experiments this was rendered impossible by the fact that the subject could not see the spot on which the experiments were performed, as this was concealed from him by a screen. Hence the place of these images is supplied by memory images connected with the tactual sensations by past experience, i. e., by association. In our experiments the assimilating visual or motor copies of past experiences are not called up by the association with the tactual sensations alone, but are suggested by other factors. In the localization of a single point, the "local sign" involved is not to be conceived of as a simple quality of the tactual sensation, but is rather a relation of association between the tactual sensation and some visual or motor image.

Another series of experiments was undertaken in the Princeton Laboratory by Dr. C. W. Hodge and myself, in which the two stimuli were successive, instead of simultaneous, as in the above experiments.

In each series of such experiments, the first point touched each time remains the same, the problem being to determine the distance from this point at which the two stimulations seem to be spatially different, and the distance at which the direction of this difference is first recognized. These two determinations may be called the thresholds for *difference* and *direction* respectively. In the results it is found that the subject, as a rule, mistakes the direction of the second point from the first after he has apparently become aware that the two points are not the same. The inference has been drawn that the difference threshold is shorter than the direction threshold. But a careful study of the answers given seems to show that this apparent recognition of difference without direction is again due to suggestion. This entire group of experiments seems to sustain the inferences drawn in the former group as to the ultimate nature of the process involved in all tactual space perception. It is an assimilation process throughout, in which visual, tactual and motor elements play the most important parts. In cases where, as in these experiments, an extensive and rapid reduction of the threshold, and a development of frequent illusions of the kind described, occur as the result of practice, the explanation of these phenomena is to be sought, not in any change in the physiological structure or functions of the tactual end-organs, nor of the centres with which these end-organs communicate, but rather in a process through which suggestion-influences get established in the reactions of the subject's attention.—G. A. TAWNEY, *Beloit College, Wisc.*

The Annee Biologique.—The new annual which has been started by Yves Delage under this title has adopted a broad policy with reference to psychology. The first number (that for 1895) has just appeared, and we are pleased to note that a large section, of over 100 pages, is devoted to this department under the head of "Mental Functions." A portion of this space is taken up with an able review of recent theories of the structure of the nervous system, by Mlle. W. Szczawinsky, but most of the section lies within the domain of psychology proper. Prof. Binet furnishes a review of the development of experimental methods, which, though necessarily brief, contains a fair résumé of the change that has come over this field within the past few years. He sums up, in particular, the work on memory, the æsthetic sense, and the physiological concomitants of mental activity, where considerable progress was made in the year 1895. The remainder of the section consists of summaries by various writers of the leading works and articles which appeared during that year. These are, in some cases, very full; about sixty contributions are noticed in all.

As the scope of the *Année* is purely biological, psychologists have certainly no ground to complain of the treatment which their science receives: the entire section is conceived in a spirit entirely friendly to its claims as a distinct science, and is written for the most part by persons who rank high in the department. If any criticism were to be offered, it would be that it is not perfectly clear why certain departments of psychology that are not mentioned do not deserve treatment in this connection fully as much as certain others that are admitted. But to suggest this would be to look a fine gift horse in the mouth, and we can do no better than express our delight at the whole-hearted recognition which the older science has here accorded to the newer. It is to be hoped that the plans of the *Année biologique* will not be altered in this respect, and that in future the psychologist may always be able to trace the progress of research on the biological side of his department by simple reference to the pages of this annual.—H. C. W.

ANTHROPOLOGY.[1]

The Tomahawk of the North American Indian.—In regard to your inquiries concerning tomahawks in the United States National Museum I would say that, in order to understand their structure, their function and the places which they supplied in the armory of the Indians of the United States it is best to remember the following facts: Aborigines of this Continent seem to have understood all the ways of killing men and animals. Before the discovery they used both poison and fire to take life, and they had the three great types of weapons, namely: for bruising, for piercing and for cutting. Adrien de Mortillet somewhere calls attention to the additional fact that each one of these classes of weapons, to-wit: bruising, piercing and cutting, is used in the hand, at the end of a handle, or thrown from the hand. You will see that underlying this division of Mortillet's we have three methods of applying force. First, directly utilizing the explosive force of human muscle. Secondly, the additional impetus given to a weighty weapon by affording it a longer excursion in the air and the added element of safety in that by means of a long handled bruiser, piercer or cutter the attacking one produces his effect at a greater distance from himself. The ballistic weapon, seldom thrown from the hand alone, acquires its velocity and additional force by means of a sling, throwing stick or a bow.

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[1] This department is edited by H. C. Mercer, University of Pennsylvania.

With this analysis in hand let us return to the tomahawk; it is a compound weapon, having for its function both bruising and cutting. It is also a handled weapon. The addition of the pike to the poll of the tomahawk is simply one of those delightful transitions which all industrial things undergo in passing from the useful into the ceremonial and mythic condition. In the aboriginal times tomahawks had no pike attachment.

The iron tomahawks in the United States National Museum are of two distinct classes: the one has an edge like a carpenter's hatchet, the other has a point and so belongs rather to the striking-piercing than to the striking-cutting apparatus of the northern type. So far as the record of these instruments go, the broad-edged, hatchet-like tomahawks were first sold to the Indians by the English and Dutch, while those with the pointed blade came through the Spaniards and the French or through southern or Latin Europeans. Indeed, the blade of this tomahawk is that of a pike and is bent at right angles so as to work with a blow rather than with a thrust.

Now, according to universal usage of savage peoples, they usually accept from civilized traders those things which supply a "long felt want." This "long felt want" is usually, both in practical life and in scientific pursuits, the consciousness of a mechanical incapacity or weakness. Very frequently the artisan knows what he wants, but he has not the practical skill to invent it. The savages of this country, then, exploited the tomahawk and took it in lieu of something they were using, but which was far inferior to their desires in this direction. For their bloody work the hatchet-tomahawk or the pike-tomahawk was a boon.

The weapons of this class which preceded the metallic ones were made of antler, in which the long prong furnished the handle and the shorter prong the working portion with or without the addition of a sharper point. In countries where the elk-horns of heavy antlers were not procurable, and good working hatchet blades of volcanic stone could be procured, the tomahawk was simply a celt or grooved blade set into a handle by one of the many ways by which hafting was formerly done.

In considering, therefore, the great mass of so-called celts and grooved axes, it must be understood that while a portion of them were industrial tools with the savage artisan, many of them were a striking-cutting weapon attached to a handle to enable the warrior to do his work at a short distance.

A most efficient form of the striking-cutting weapon was the Mexican battle-axe, consisting of a handle of wood along the edges of which spalls of obsidian and rugged stone were set. In some instances these chipped blades were placed so close together and in such regular fashion as to suggest the first steps in the invention of the sabre which is a striking-cutting weapon.

Some of the Siouan tribes of the Missouri River, in later days, inserted heavy spikes or blades of butcher's knives and other blood-curdling objects, doing their work precisely after the fashion of the Mexican axe.

In the Antillian area and over nearly all of South America north of the parallel of Rio Janeiro, the blades of the tomahawks and battle-axes were exquisitely fashioned and polished.—Otis T. Mason.

A Triple Indian Grave in Western New York.—On September 10, 1885, I opened an Indian grave which was of interest in many ways. In the first place, it was located near the site of Gana-garū, which was, for many years, the principal village of the Seneca nation, and for which they seem to have had an unusual degree of pride and affection. This village was destroyed at the approach of De Nonville's invading troops in 1687, and was never rebuilt, perhaps from sentimental motives. This village site occupies an area of at least ten acres, and is still marked by burnt soil, chips of chert—brought from a distance—fragments of pottery and of clay pipe-stems and even more perfect relics. During the early days of the American village of Victor, the settlers depended for old iron largely upon the lost tomahawks of the Indians, and quantities of French glass and wampun beads, of chert and brass arrow-heads and of many other relics, attest the richness of this Indian capital.

During the spring of 1885, Mr. George Ketchum, residing near Victor, plowed out a brass kettle and a few bones from the brink of a slight fall of land. It is at such places as this that the plow is most likely to detect ancient interments, the earth being gradually carried down hill so that after the lapse of years, the original grade has been so changed that the plow hooks into a skull, throws up a long bone, or tears out some article deposited with the skeleton.

At my visit, it was comparatively easy to expose the remaining contents of the grave. The bones of the skeletons were not all present, suggesting either that they had been disturbed by burrowing animals or that the interment had been made after prolonged exposure on an aerial scaffold as was practiced almost uniformly by many tribes, and, to some extent, by the Iroquois. In burials after exposure on scaffolds, however, a dozen or twenty bodies were usually collected and interred almost without relics and in a very limited area. Other burying places were noted in the same field, but at much greater distances than usual.

While it was impossible to ascertain the exact attitude in which the bodies were laid, all of the heads pointed toward the west, and the mummy position, so frequently noted in graves of the Iroquois, was not apparent. Of the three skeletons, one was conspicuous for its development, though not for its height. The femurs showed a "third trochanter" almost as plainly as do those of the horse, while, in most human skeletons, this projection has become merely a roughening of the bone. The skull showed the lines of muscular attachment as I have never seen on another, and, in general, it was evident that this warrior must have been a person of tremendous physical development. The comparatively open sutures of the skull showed that he was still below middle age, though fully matured. The second skeleton was that of an adult of moderate build and apparently older than the first. The third skeleton, which was very incomplete, was that of a small child. The molars, which are usually cut in the sixth year, were not quite out of the bone of the jaws.

At the neck of the first skeleton, so as to discolor the upper part of the breast bone and the first ribs, was a string of brass beads. These had oxidized, and the verdegris had preserved the leathern string on which they were worn, so that the loose single bow-knot, tied many years ago, has remained intact. A number of red stone beads had fallen away from the neck and lay at the level of the bottom of the grave. These were square on section, of about an inch in length, and some were nicked or rudely ornamented. They appeared to be made of the western pipe-clay; at any rate, they were of material not found for many miles about the site of the grave. A pipe-stem, of the clay of the vicinity, was found near this skeleton, and at the feet was a brass kettle. At the feet of the second skeleton was another kettle and part of an iron knife, rusted almost to disintegration. With the child's skeleton was found a brass sleigh-bell. Besides these relics must be counted the kettle plowed out of the grave in the spring.

Within the kettle found near the feet of the second skeleton was a mass of vegetable fibre resembling moss. A similar mass found in a kettle buried with a skeleton at the village site mentioned, showed a right-angled crossing of some bands of fibres, and strongly suggested that the decayed vegetable tissue had been a basket or some similar plaited receptacle.

It is possible to compute the age of this interment within somewhat wide limits. Articles of European manufacture had not become common among the Senecas of this region till within quite a short time of De Nonville's expedition. On the other hand, the history of Victor goes back about a hundred years, so that it is practically certain that this grave is not earlier than 1650 nor later than 1800. So far as could be judged by the appearance of the bones—by comparison with others in which some idea of the age of interment may be formed—and by the state of preservation of the relics, the remains date back of English influence and come within the period of French influence, somewhere about the close of the seventeenth century.

The grave referred to as opened at the site of the village of Ganagarū, was described in the NATURALIST several years ago. The skeleton was that of a young person, the wisdom-teeth not having been fully developed and the bones being immature, though nearly of adult size. The body had been put or had been left in the "mummy attitude," with elbows and knees bent at the sides of the trunk. Strangely enough, the remains were found head downward. With this skeleton rested that of a turtle—perhaps indicating the clan of the deceased—thirty feet of French glass beads, ninety feet of wampum, a brass kettle, a bone head-comb, showing in silhouette, the figures of a man on horseback and of another person standing behind him, and other ornaments. These would seem to indicate that the person was a woman, and doubtless a young lady of distinction, from the wealth buried with her.

Other burials in the same vicinity have shown somewhat similar relics, and belong to the period when the wares of the French traders were mingled with the weapons and implements of the Stone Age.

A. L. BENEDICT.

SCIENTIFIC NEWS.

Mr. J. E. S. Moore has an interesting sketch of some of the faunal features of Lake Tanganyika in *Nature* of July 1. He concludes "that the fauna of Tanganyika is comparatively old, for it is unlike anything now inhabiting the sea, and if it is derived form a previous freshwater stock, much time would be required for the evolution of its widely divergent present forms."

The natural history building of the University of Illinois, dedicated a few years ago, was struck by lightning on June 17 and partially destroyed. The greatest damage occurred in the botanical and geological departments; the library and the zoological collections were but slightly injured. The total loss is estimated at $8000.

Dr. James Ellis Humphrey, Associate Professor of Botany in Johns Hopkins University, died in Port Antonio, Jamaica, August 17, at the age of 36. Dr. Humphrey had agreed to be one of the Botanical Editors of the American Naturalist, under its new management. A sketch of his life will appear in our next number.

The recent appointment of Mr. Ernest William MacBride, fellow of St. Johns College, Cambridge to the professorship of zoology in McGill University, Montreal, marks a distinct step in advance in that institution. Professor MacBride is well known through his researches on the embryology of Echinoderms and Batrachia.

Dr. Japetus Steenstrup, until 1885 professor of zoology in the University of Copenhegen, has just died. He was born March 8, 1813. His work was largely in the line of marine zoology and his essays on hermaphroditism and on alternation of generations attracted wide attention in their day.

The efforts made to have natural history specimens admitted to the mails of the Universal Postal Union has met with partial success in so far that these objects are now classified as samples and are charged postage at the rate of one cent for every two ounces.

The plans and significations for the new wing of the American Museum of Natural History in New York, have recently been approved and bids for the construction of the addition are now being received.

A new journal is the Annotationes Zoologicæ Japonensis. The first number contains a short but interesting sketch of biology in Japan by Professor Mitsukure.

The Cagnola prize of $500 and a gold medal have been awarded to Prof. Ferdinando Sordelli for his memoir on the vegetation of Lombardy in geological time.

Nearly 300,000 francs has been subscribed to the fund for a monument to Pasteur in Paris. The commission for the statue has been given to M. Falguières.

Professor H. W. Conn of Wesleyan University will spend next year in Europe. His biological courses will be conducted by Mr. Estin during his absence.

Professors Wilhelm His and A. Ramsay have received the honorary degree of Science from the University of Dublin.

Mr. A. W. Bennett succeeds Prof. T. Jeffrey Bell as editor of the Journal of the Royal Microscopical Society.

Professor Sollas of Dublin, goes to Cambridge as successor to the late Professor Green in the chair of Geology.

A zoological club has been organized at Springfield, Mass. with a membership of nineteen.

Prof. T. W. Engelmann of Utrecht, goes to Berlin as Professor of Physiology.

Professor Leuckart has been made a Knight of the Prussian Order of Merit.

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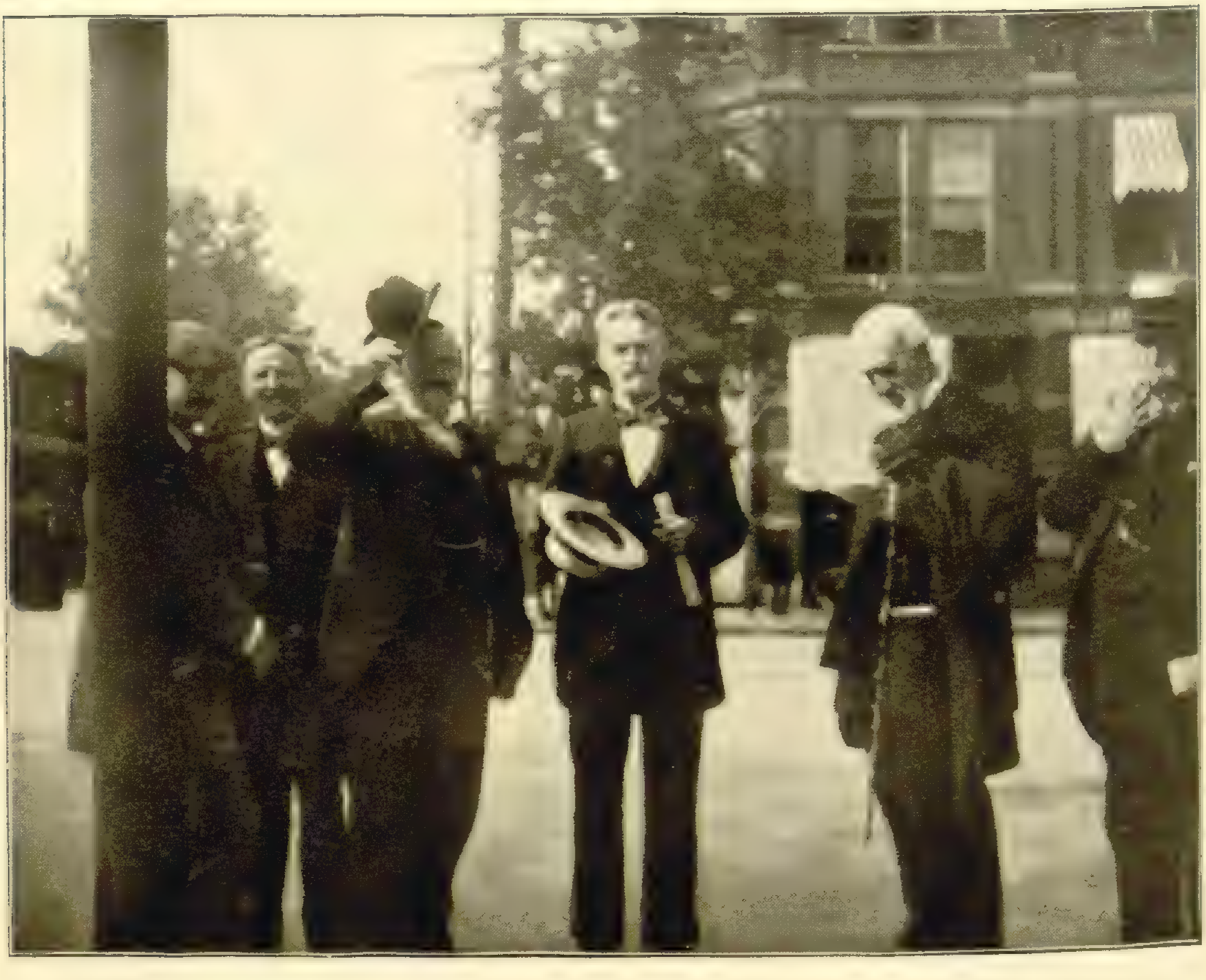

THE LAST PHOTOGRAPH OF PROFESSOR COPE.

Taken by Dr. F. C. Robinson at the Buffalo Meeting of the American Association for the Advancement of Science, 1896.

THE

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EDWARD DRINKER COPE, NATURALIST—A CHAPTER IN THE HISTORY OF SCIENCE.[1]

BY THEODORE GILL.

I.

> Bitter constraint, and sad occasion, dear,
> Compels me to disturb your season due;
> For Lycidas is dead, dead ere his time,
> Our Lycidas, and hath not left his peer.

On the morning of the 13th of April, in a car on my way from a funeral in New York to Washington, a newspaper notice of the death, the day before, of my old friend, E. D. Cope, caught my eye. Shocked by the intelligence, I dropped the paper, and memory recalled various incidents of our long acquaintance.

The threnody of Milton[2] in commemoration of his friend Edward King, also rose to recollection, and the lines just quoted seemed to me to be peculiarly fitted for the great man just dead. He was, indeed, no longer young and had attained his prime,[3] but he had planned work for many years to come, and had well advanced in the execution of some of it. He had truly died before his time and had left no peer; the greatest of the long line of American naturalists was prematurely snatched from science and from friends.

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[1] Address by the retiring President of the American Association for the Advancement of Science at the Detroit Meeting, August 9th. Also printed in "Science," August 13, 1897, and in the "Scientific American Supplement," Aug. 14, 28, Sept. 4, 11, 1897.

[2] Milton, Poems, XVII.

[3] In the extract from Milton's poem, *time* has been substituted for *prime*, and *our* for *young*.

My acquaintance with Cope began in 1859. While looking through the part of the Proceedings of the Academy of Natural Sciences of Philadelphia for the month of April, in which my first paper published by the Academy had appeared, I found one by E. D. Cope "On the Primary Divisions of the Salamandridæ." It seems that the papers by Cope and myself had been passed on by the Committee on Publications on the very same day (April 26th), and appeared in print in juxtaposition. I had not previously heard of the new devotee of science, and read his article with as much interest as my own. A well-equipped man had evidently come upon the field and this was the first of the numerous articles that were destined to appear in an uninterrupted flow for nearly four decades. A few months afterwards I met the author in Philadelphia at the Academy. A young man, nineteen years old, about 5 feet 9 or 10 inches high, with head carried somewhat backwards and of rather robust frame, stood before me. He had an alert, energetic manner, a pronounced, positive voice, and appeared to be well able to take his part in any trouble. His knowledge was by no means confined to herpetology, but covered a wide range of science, and his preliminary education had been good. We afterwards met from time to time in Philadelphia and Washington, and found we had many sympathies in common and some differences.

In one of our first interviews we had quite an argument on the nature of the family group in zoology, resulting from criticisms I had made on the extended scope he had given to that category in the classification of the Salamanders. Another controversy, I remember, had reference to the vertebral theory of the skull. In an article on the venomous serpents, published in the Proceedings of the Academy for 1859, he had defined the group in terms involving the adoption of that theory, and I ventured to dissent from its reality. I had myself been much impressed with it in former days, and when 16 years old had copied in colors an illustration of Owen's so-called archetype reproduced in Carpenter's Physiology. Subsequently, however, the fact that there was only an approximation to the realization of it in the most specialized of fishes and not at all among the lower or higher vertebrate, with other considerations, turned me from it, and I gave my reasons for dissent to Cope. Ultimately he admitted the force of the argument, and also abandoned the theory at one time so popular in England and America.

Our acquaintance, thus begun in 1859, continued uninterruptedly till death divided us. We rarely met, indeed, that we did not express difference of opinion respecting some subject, but the difference was never of a serious nature, and generally little more than sufficient to enliven intercourse.

II.[4]

The future naturalist was born in Philadelphia on the 28th of July, 1840, and the name Edward Drinker was given to him. He was the descendant of a prosperous line long established in Pennsylvania. His father, Alfred was a man of cultivated literary taste, and did much to train his son's mind in early youth. He had retired from active business and lived in luxurious ease near Germantown,[5] a suburb of Philadelphia. There he had formed an arboretum containing most of the American trees which would thrive in the climate of that region. Amidst such surroundings the youthful Cope grew up.

An active and intelligent interest in Nature became manifest at a very early age. When only about seven years old, during a sea voyage to Boston with his father, the boy is said to have kept a journal which he filled with drawings of "jelly fish, grampuses and other natural objects seen by the way."

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[4] I am indebted to a brother in-law of Prof. Cope, Mr. Philip C. Garrett, for fuller information and rectifications of statements made in the original address, which I have utilized in this edition in the form of notes.

[5] According to Mr. Garrett, "in strict accuracy, his father either had not retired from active business or had never been in it, having been and remaining what is called an active partner of H. & A. Cope, though, it must be admitted, a rather inactive one at all times through very poor health. The home in which Edward was reared from early boyhood was not in Germantown, but about a mile east of it on the York road."

When eight and a half years old he made his first visit to the Museum of the Academy of Natural Sciences of his native city; this visit was on the "21st day of the 10th Month, 1848," as entered in his journal. He brought away careful drawings, measurements and descriptions of several larger birds, as well as of the skeleton of an Ichthyosaurus. His drawing of the fossil reptile bears the explanatory legend in Quaker style: "two of the sclerotic plates look at the eye—thee will see these in it."

At the age of ten he was taken upon a voyage to the West Indies.[6] What were the impressions he derived from that voyage we have not been told. But what has been communicated amply justified Professor Osborn in his declaration that "the principal impression he gave in boyhood was of incessant activity in mind and body, reaching in every direction for knowledge, and of great independence in character and action." His school[7] education was mostly carried on in the Westtown Academy, a Quaker institution about 23 miles west of Philadelphia. One of his instructors was Dr. Joseph Thomas, a well known literary worker of Philadelphia and future author of a "Universal Pronouncing Dictionary of Biography and Mythology" (1870), and said to have been an "excellent linguist." Under his guidance Cope obtained a passing knowledge of Latin and Greek. He appears to have had no instruction in any biological science and had no regular collegiate training. He did, however, enjoy the advantage of "a year's study (1858–9) of anatomy and clinical instruction at the University of Pennsylvania," in which the illustrious Leidy was professor of anatomy. But, in the words of his literary executor (Professor H. F. Osborn), "it is evident that he owed far more to paternal guidance in the direct study of nature and to his own impulses as a young investigator than to the five or six years of formal education which he received at school. He was especially fond of map drawing and of geographical studies."

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[6] Osborn, in *Science*, N. S., V, 706.

[7] Mr. Garrett informs me that Cope's "education appears to have been received at home until 1851; then for two years at the Friends' Select School in Philadelphia; from 1853 to 1856 at West Town, and from 1856 to 1859 by private tuition, and then again at the Select School in Philadelphia.

While a school boy he relieved his studies of the classics and the regular course in which boys of his age were drilled by excursions into the fields and woods. Reptile life especially interested him, and he sought salamanders, snakes and tortoises under rocks, stones, fallen trees and layers of leaves, as well as in the ponds and streams of his vicinage. The trophies of his excursions were identified from descriptions in the works in which they were treated, as well as by comparison with identified specimens in the museum of the Academy. He early and almost without guidance learned to use the library and collection of the Academy, although he did not become a member until he came of age in 1861.

Cope's first contribution to the Proceedings of the Academy appeared in the part covering April, and was "On the Primary Divisions of the Salamandridæ, with Descriptions of the New Species."[8] In this maiden paper he instituted important modifications of the systems previously adopted in the United States. He soon afterwards catalogued the serpents preserved in the museum of the Academy of Natural Sciences and likewise improved upon the systems previously in vogue. He continued with various papers, describing new species and giving synopses of brief monographs of sundry genera of lizards and anurous amphibians.

For five years his publication was confined almost exclusively to the reptiles and amphibians. (The continuity was only interrupted once in 1862, when he described a new shrew caught by himself in New Hampshire.)[9] Not until 1864 did he begin to extend his field. In that year he described various fishes and a supposed new whale, and gave his first contribution to paleontology in the description of the stegosaurian amphibian called *Amphibamus grandiceps.* But although his attention had become thus divided, he never lost his interest in herpetology and continued to the end of his life to devote much attention to that department. His studies extended to every branch of the subject, covering not only specific details and general taxonomy, but also the consideration of anatomical details, the modifications of different organs, geographical distribution, chronological sequence, genetic relations and physiological consequences. So numerous were his memoirs, so entirely did he cover the field of herpetology, and so marked an impression did he make on the science, that he was well entitled to apply to himself the boast of the Vergilian hero, "*Pars magna fui.*"

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[8] Proc. Acad. Nat. Sci. Phila., 1859, pp. 122-128.

[9] An unentitled communication upon certain cyprinoid fish in Pennsylvania was published in the Proceedings of the Academy of Natural Sciences early in 1862 (Proc. 1861, p. 522-524); It is not included in the list of Cope's papers in the catalogue by the Royal Society.

In his earliest essays he manifested the independence and critical spirit which were so characteristic of him later. One knowing all the circumstances of the case may be amused in coming across a passage expressed in the tones of a veteran published by him when 20 years old: "In proposing the name Zaocys * * * we are giving expression to an opinion *long held by us* as to the unnatural association of species in the so-called genus *Coryphodon* * * *. In it we find cylindrical terrestrial species united with compressed subarboricole species, upon a peculiarity whose value as an index of nature appears to us entirely imaginary. The very nature of the *coryphodontian* type of dentition, as distinguished from the *isodontian* and *syncranterian*, would lead us to infer its inconstancy;" and so on.[10] Bold as was the criticism of such herpetologists as Dumeril, Bibron and Günther, it was justified by the facts, and the young author's conclusions have received the endorsement of the best succeeding herpetologists, including even the latest author criticised.

In 1863 he paid a visit to Europe, partly for the benefit of his health which had suffered from overwork, and partly for the purpose of seeing the great museums of England, France, Holland, Austria and Prussia. Notwithstanding his ailments, he made good use of his time abroad and systematically examined the collections of reptiles in the chief centers of science. He did not even restrict his studies to herpetology, but extended them to various other subjects.

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[10] Proc. Acad. Nat. Sci., Phila., 1860, p. 563.

On his return from Europe in 1864, he was appointed professor of natural science in Haverford College, an institution chiefly supported by Quakers, but retained the position only three years. During this time, in 1865, he married Miss Annie, daughter of Mr. Andrew Pim, of Chester County, Pa.

In and after 1864, too, he enlarged the range of his studies and publications and also extended them to ichthyology, mammalogy and paleontology. He had always been interested in the philosophical aspects of science and early adopted the conception of descent with modifications to account for the variations of animals and the differentiation into species and higher groups, and in 1869 began to give expression to his peculiar views.

On the death of his father[11] he became heir to a considerable fortune. Part of this was invested in mines which for a short time gave promise of good returns, but, it is said, the majority of the stock was held by others, and owing to the incapacity of superintendents and the operations of the controlling stockholders, he losts his interests. While in the enjoyment of his fortune he spent large amounts in collections and personally conducted or sent out expeditions to various places. One of the most important was sent to South America. He filled a large house from cellar to topmost story with his collections and resided in an adjoining one.

In 1871 he conducted an expedition to Kansas and especially investigated the Cretaceous beds of that State and collected their fossils. In 1872 and 1873 he became connected with the U. S. Geological Survey, and for the fossils visited Wyoming in the former year and Colorado in the latter. In 1874 he joined the survey under the command of Lieut. Wheeler, of the Engineers, and explored New Mexico.

The collections made during these expeditions were large, and the unwearied industry and energy, as well as cares, of Cope were rewarded with many well-preserved fossils. These were described in many communications to the Academy of Natural Sciences and the American Philosophical Society, and later in large volumes published by the general government as reports of the respective surveys with which he was connected.

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[11] Cope's father died December 4, 1875.

The various investigations thus opened were continned through the succeeding years. His collections continued to grow in spite of reduced means. He refused even to sell portions for which he was offered liberal sums, and, at the cost of personal discomfort, held on to them and made his home, for much of the time, in the midst of them, having sold his residential house but kept his museum.

In 1878 he purchased the rights of the proprietors of the AMERICAN NATURALIST and removed it to Philadelphia. Professor Packard, one of the original proprietors, cooperated with him in the editing of it for some years, and he was also assisted by various eminent specialists. In this journal numerous articles of all kinds, including reviews and editorial comments, were published by him. His last words appeared in numbers issued after his death, the leading article in the number for June having been written shortly before his death; it treats of the remarkable mammals of South America, known as Toxodontia.

In 1886 he received an appointment to a chair in the University of Pennsylvania and became professor of geology and paleontology. Such a man naturally awakened the interest of apt pupils, and he was a facile and entertaining lecturer. From the stores of a rich memory he could improvise a discourse on almost any topic within the range of his varied studies. His views were so much in advance of those in any text-book that for his own convenience, no less than for the benefit of his pupils, he felt compelled to prepare a "Syllabus of lectures on geology and paleontology," but only "Part III, Paleontology of the Vertebrata," was published. It appeared in 1891, and is still a valuable epitome of the classification of the vertebrates, recent as well as fossil, giving in dichotomous tables the essential characters of all the groups above families and also the names of all the families. His own industry and investigations did much to render this antiquated in even six years, and a new edition of work became necessary. "Upon the Tuesday preceding his death he sent to the press an elaborate outline of his University lectures containing his latest ideas of the classification of the Vertebrata.[12]

The enormous mass of publications constantly flowing from his own pen might lead one unacquainted with the author to suppose that he was probably a recluse, but there were few men of his intellectuality who were less disposed to seclude themselves. He enjoyed and gave enjoyment to intellectual company and was a brilliant conversationalist. He was especially fond of academical meetings and was an unusually frequent attendant at the meetings of the American Association as well as of the National Academy of Sciences. His election to the Presidency of the American Association was highly esteemed by him and doubtless his address would have been a notable one.

In February (1897) Cope's health became seriously affected by a nephritic disorder, which, it is said, "might possibly have been remedied by a surgical operation," but to this he would not submit.[13] Notwithstanding failing health, he continued active almost to the last. Finally, the insidious disease invaded his entire system and he died on the 12th of April, in the room he had long used as a study, surrounded by the objects of his life-long attentions.

Such were the chief episodes of Cope's individual life; the facts known are few, and the record belongs rather to his family than to us. But Cope's real life was in his work, and to the consideration of that work we may now proceed. Let us adopt the order in which he took up the subjects of his investigations and successively look into his contributions to herpetology (III), ichthyology (IV), mammalogy (V) and paleontology (VI); we may then examine his philosophical views and especially those relating to evolution (VII); finally we may attempt to forecast the position he is destined to enjoy in the history of science (VIII). To know him as he was we must recognize his weakness as well as his strength. He himself has wished this and has asked in the spirit of the Moor:

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[12] Osborn in *Science*, May 7, p. 705.

[13] According to Mr. Garrett, "as regards the disorder of which he died, it was cystic, not nephritic, the *post-mortem* showing little disease of the kidneys. The surgical operation he intended to undergo, but became too ill before it was accomplished."

> Speak of me as I am; nothing extenuate,
> Nor set down aught in malice.

III.

The extent of Cope's contributions to herpetology have been referred to. Herpetology was his first love and continued to be the favorite branch of science to his life's end. His impress on it was, in some respects at least, greater than on any other of the sciences he cultivated, and doubtless the systems he introduced, with some modifications, will be the most lasting. He found herpetology an art; he left it a science: he found it a device mainly for the naming of specimens; he left it the expression of the coordination of all structural features. The reformations he effected in the classification of the anurous amphibians and the saurian reptiles were especially notable.

The anurans had been chiefly differentiated in groups on account of the most superficial characters. Such were the modes of fixation of the tongue or its absence, the development of disk-like expansions of the tips of the toes or simply attenuated toes, and the presence or absence of teeth in a jaw. Cope proceeded to investigate the group in an anatomical manner and reached entirely new conclusions. He found that important differences existed in the structure of the sternum, and especially in the connection of the lateral halves. In the common toads and tree toads of Europe and North America the so-called clavicle and coracoid of each side are "connected by a longitudinal arched cartilage which overlaps that of the opposite side," while in the common frogs the clavicles and coracoids of both sides are connected by a single median cartilage. The former type is now known as the arciferous and the latter as the firmisternal. Although Cope was the first to appreciate the significance of those characters, he did not at once fully realize their morphological value, the name Arcifera having been originally applied by him only to types of that group having teeth. Ultimately he did so, and his views have stood the test of time and the latest critical investigations.

He also found that the characters so revealed served to fix the places in the system of the groups in question. In their early stages the Firmisternials (or frogs and their relations) have the shoulder-girdle moveable, and thus resemble the Arcifers (toads, etc.), which have the opposite halves movable during their whole life time; thus it became evident that the latter are the lowest or most generalized forms, and the former more advanced and higher in the system. The development of teeth, which had been supposed by the earlier systematists to be of paramount value, and which Cope, following in their footsteps, had also originally unduly valued, has been found to be of quite subordinate importance.

The lizards were also in former times distributed into families and other groups on account of variations in superficial or external characters, such as the form of the tongue, the arrangement of the scales and the development of legs and feet. Cope dissected examples of all the types he could obtain and found that such superficial characters were often misleading, and he proceeded to arrange them with reference to the preponderance of all characters. The structure of the cranium especially was analyzed, and the variations and concordances in the development of various bones were tabulated. These characters were supplemented by others derived from the vertebræ, the shoulder girdle, the teeth, the tongue and the pholidosis. Familiarity with his subject enabled him almost instinctively to assess the relative values of the different characters, and he obtained fitting equations which resulted in a system which has received the approbation of the most competent judges to the present time.

The extent of Cope's influence on herpetology may be to some extent inferred from the catalogues of the richest collection of reptiles and amphibians in existence—the British Museum's. Descriptive catalogues of both the Anurans and Saurians have been published at different times. In the early catalogues are adopted the views current at the dates of publication—1845 for the lizards; 1858 for the batrachians. New editions were published many years later and the systems of Cope were adopted with slight modifications. In his catalogue on the *Batrachia salientia* Mr. Boulenger, the author, remarked that it appeared "undeniable that the principles of classification laid down by Mr. Cope are more in accordance with the natural affinities of the genera of tailless Batrachians than those employed by other authors; this is amply proved by all we know of their geographical distribution, development and physiology."

In an article[14] published in advance of his catalogue of the lizards, Boulenger states that the old classifications are, "on the whole, as unnatural as can be" and that, "like Cope, whose lizard families I regard as the most natural hitherto proposed, I shall lay greater stress on osteological characters and on the structure of the tongue."

It was a long time, however, before Cope's views became popular. Even anatomists of repute refused to follow him. One[15] of them, for example, admitted that "skeletal characters are, indeed, most valuable ones in leading us to detect the deepest and truest affinities of vertebrates, but [he urged] these affinities once found, it is very desirable that zoological classification should not, if it can possibly be avoided, *repose* upon them only, but rather on more external and more readily ascertainable characters." He, therefore, ventured "to propose a classification derived from that of Dr. Günther."

Cope replied[16] by a fierce review of the work of Dr. Günther, and concluded with the utterance that such views "will only interfere with the progress of knowledge if sincerely held and believed."

But such views were evidently sincerely believed and they did retard the progress of science. An eminent Russian herpetologist objected to the use of anatomical characters. He especially protested against those employed by Boulenger after Cope to the grouping of the lizards, and Mr. Boulenger considered it incumbent on himself to defend the practice of using such characters;[17] he aptly replied that the use of "purely external characters * * * does not meet the requirements of modern science," and that classifications are not made simply "for the convenience of beginners."

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[14] Synopsis of the families of existing Lacertilia. Ann. and Mag. Nat. Hist. (5), XIV, 117.

[15] Mivart in Proc. Zool. Soc. London, 1869, p. 2-1.

[16] Cope in Am. Journ. Sci. (3), I, p. 203.

[17] Boulenger in Ann. and Mag. Nat. Hist. (5), XIX, 385.

At last, however, the principles of classification adopted by Cope have become generally accepted, and doubtless this was in no small degree hastened by their application to all the amphibians and reptiles by Boulenger.

Cope's attention to the extinct reptiles was excited by the examination and consideration of a Carboniferous lizard-like amphibian which he was requested in 1865 to report upon. It was a new species which he named *Amphibamus grandiceps* and considered to be the type of a new order to which the name Xenorachia was applied, but which he subsequently referred to the new comprehensive order Stegocephali.

He sought for specimens of the extinct species with as much enthusiasm as he had for the recent. Extinct and living he considered together and light was mutually reflected from the two to guide him in the perfection of the entire system. In 1869 he gave expression to the results of his studies in a well illustrated "Synopsis of the Extinct Batrachia, Reptilia and Aves of North America." This was supplemented in 1874 by addenda and a "Catalogue of the air-breathing Vertebrata from the coal measures of Ohio."

A rich field was opened to him in 1877, when he received the first instalment of reptilian remains from Texas, which were at first considered to be of Triassic age, but subsequently determined to be Permian. Successive instalments of amphibian as well as reptilian skeletons enriched his collection, and his investigations revealed a new and wonderful fauna rich in species and often differing widely from any previously known. These were described in many articles. The results for the amphibians were summarized in 1884 in a memoir on the "Batrachia of the Permian period of North America."

The Permian amphibians were found to vary much in the composition of their backbones. Instead of having single centra arranged in a continuous row as in existing Vertebrates, they had distinct bones on which were devolved portions of the functions fulfilled by the centra of higher Vertebrates.

Some had "the vertebral bodies represented by three segments each, a basal intercentrum and two lateral pleurocentra;" these were named "Ganocephali" and "Rhachitomi." Some "differ remarkably from all other Vertebrata in having between the centra another set of vertebral bodies, so that each arch has two corresponding bodies;" these were called "Embolomeri."

In tracing the development of these bones, Cope came to the conclusion that they were only partially represented in higher or more specialized types; they did not become consolidated, but one or the other became reduced and finally lost or at least greatly atrophied. In the living amphibians the vertebral centra are homologous only with the intercentra, while, on the contrary, the centra of the reptiles, birds and mammals are represented by the pleurocentra of the Rhachitomes.

The studies of Cope on those classes which had earliest attracted his attention were more nearly completed than for any others. Many years ago he had contemplated the publication of monographs of the amphibians and reptiles of North America and happily he had at last finished his work.

In 1889 his monograph of the "Batrachia of North America" was given to the world as a Bulletin of the United States National Museum (No. 34). It forms a goodly volume of 525 pages illustrated by 81[18] plates and 120 figures inserted in the text. No large country has a more elaborate and scientific exposition of the class than is given in this volume. A synopsis is furnished of all the families and genera wherever found, and detailed descriptions are supplied for all the groups and species represented in the zoological realm of North America, 31 genera and 107 species are recognized, and of these Cope had first made known about a quarter, 7 of the genera and 27 of the species having been described by himself.

Shortly before his death, and during his last visit to Washington he delivered to the National Museum the report on all the reptiles of North America which he had been long preparing. This was prepared on the model of his "Batrachia of North America," but will, of course, be a much larger work, inasmuch as there are nearly three times as many reptiles as batrachians.[19] His last elaborate memoirs dealt with special anatomical features of the serpents and lizards, which he examined with the view of perfecting the system of those groups.

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[18] The last plate is numbered 86, but five were cancelled, 80, 81, 82, 84 and 85.

IV.

In 1864 Cope[20] became especially interested in the fresh-water fishes of the United States, and then as well as in succeeding years published enumerations and descriptions of many species. His first papers in 1864 and 1865 were "On a blind Silurid from Pennsylvania" and a "Partial catalogue of the cold-blooded Vertebrata of Michigan;" in 1868 he published "On the distribution of fresh-water fishes in the Allegheny region of southwestern Virginia," and in 1869 appeared a "Synopsis of the Cyprinidæ of Pennsylvania." In addition to these, various minor papers were published, and in some of them marine forms were considered.

When in Europe he had purchased a large collection of skeletons of fishes from all parts of the world prepared by Professor Joseph Hyrtl, of Vienna, one of the most skillful practical anatomists of the day. He had a number of other skeletons made to represent missing types. With these as a basis he proceeded to recast the classification of fishes. The first contribution to the subject was embodied in an introductory chapter of his "Contribution to the Ichthyology of the Lesser Antilles," published early in 1871.

The same chapter, with the same title, "Observations on the Systematic Relations of Fishes," but with some modifications and additions, was later published in the Proceedings of the American Association for the Advancement of Science for 1871. This was a notable paper and replete with original observations of value. It was not, however, up to the standard of his work on amphibians and reptiles. The subject, indeed, was too vast and only a superficial examination was made of special parts. It was not a classification based on the examination of the entire structure, but rather an exposition of the development of a few particular characters, which more experience subsequently convinced him were of less value than he had supposed. Nevertheless, in some respects the proposed classification was much in advance of those previously adopted, and useful hints were given for the further improvement of the system.

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[19] Cope's monograph of the reptiles will not include the tortoises, those having been left to Dr. G. Baur to monograph.

[20] A short unentitled communication (before alluded to) was pulbished as early as 1863.

Later Cope followed up this attempt at the reformation of the ichthyological system with several others especially treating of extinct types. One of them, "On the classification of the extinct fishes of the lower types," was published in the Proceedings of the American Association for 1877. The results of his studies were summarized, in 1889, in "A synopsis of the families of Vertebrata," and two years afterwards (1891) with modifications, in an article "On the non-actinopterygian Teleostomi." These results were very valuable, and attention was for the first time directed to the importance and morphological significance of the skeletal fin structures of the ancient fishes long confounded under the name of Ganoids. Instead of this single order (or subclass) of the old systematists, he named four superorders of the Teleostomi or true fishes, and recognized seven orders, including the old ganoids after eliminating the Lepidosteids and Amiids, which were referred to the Actinopterygians. Only two of the seven orders are represented by existing forms—one (*Cladistia*) by the bichirs of Africa, and the other (*Chondrostei*) by the sturgeons.

His work on the extinct fishes was incomparably better than any that had been done before in the United States. He far surpassed all his predecessors, not only by his knowledge of morphological details manifest in the extinct as well as living forms, but by his keen philosophical instinct and taxonomic tact. But this philosophical instinct was sometimes at fault, and occasionally he indulged in the wildest speculations, for which he has, not unjustly, been taken to task. Yet even his blunders were the result of the facility of his mind in seizing and adapting the latest utterances of science. One notorious case may be given. The great Russian embryologist Kowalevsky published a memoir sustaining the thesis that the Tunicates were members of the vertebrate phylum, and that the larval stage of most of the species had the homological equivalent of the backbone of the true vertebrates. Cope foresaw the morphological consequences of this view and sought the vertebrates nearest the Tunicates. He settled upon some strange forms of the Silurian and Devonian times known as Pteraspids and Cephalaspids. They were the earliest known of vertebrates and, therefore, likely to be the most primitive in structure. Most of them had a shell-like encasement, composed of bone-like plates. He happened to find illustrations of the living *Chelyosoma*, a true Tunicate, having a system of plate-like indurations of the integument, somewhat similar in appearance to those of some of the ancient fishes. It was assumed that this mere superficial similarity indicated genetic relationship. To those acquainted with the structure of *Chelyosoma* this approximation seemed strange indeed ; its anatomy was known and the form is simply a well marked relation of the typical Ascidiids, but highly specialized by the development of integumentary plate-like horny indurations. Histologically and otherwise they were very different from the plates of the extinct armored vertebrates. Cope's guess was simply the result of the tendency to jump at conclusions which he was constantly obliged to curb, and unfortunately he rushed into print before he had time to think. He soon reconsidered the case with calmer mind, and abandoned his hypothesis. Few men were ever more willing to reconsider evidence and retrace false steps than was he.

In spite of errors of detail and somewhat hasty generalization the ichthyological labors of Cope were unusually valuable contributions to science, and the progress of ichthyology has been much accelerated, not only by these labors, but by the investigations they challenged.

V.

Cope's attention was early drawn to the mammals. His first published article (1863) was a description of a supposed new Shrew found in New Hampshire, and in 1865 he described various cetaceans. In 1868 he began the collection and investigation of the fossil mammals of the western territory, and thenceforward devoted the larger share of his attention to the description and restoration of the numerous new species which he from time to time brought to light. The previous investigators of the extinct mammals of America had almost exclusively confined themselves to descriptions and illustrations of the crania and dentition, but a new era was introduced when Marsh and Cope sent out exploring expeditions or themselves collected. No parts of skeleton were neglected; all were collected. Gradually the numerous bones from different parts of the skeleton were identified, and finally many of the beasts of old were resurrected into skeletons almost as complete as those just divested of muscles.

The discoveries resulting from such thorough work quite modified or even overturned old conceptions. It became evident that there was a great contrast between the development of the mammals and that of the invertebrates, and even, though in a less degree, of fishes. It appeared that there was a much more rapid process of evolution for the mammals than for the lower classes. All the mammals of the oldest of the Tertiary periods were strange and very unlike those of recent times, and no descendants of even the same families lived to be the contemporaries of civilized man. The views of the founder of vertebrate paleontology were also to a considerable extent subverted. Cuvier taught that there was always a coordination between the various systems of the animal frame and that from the remains or impress of one part the approximate structure of the other parts could be inferred. He even pushed this doctrine to such an extreme that he overlooked some obvious counter facts. One such case is so remarkable because it originated with Cuvier and was endorsed by Huxley[21] that it is worthy of mention here, and Huxley's introduction to it and translation of it may be given. Huxley himself protests against the too literal application of Cuvier's law, and recalls Cuvier's own reserve:

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[21] Huxley: "Introduction to the Classification of Animals," 1869, in first chapter "On Classification in General."

Cuvier, the more servile of whose imitators are fond of citing his mistaken doctrines as to the nature of the methods of paleontology against the conclusions of logic and of common sense, has put this so strongly that I cannot refrain from quoting his words.[22]

"But I doubt if any one would have divined, if untaught by observation, that all ruminants have the foot cleft, and that they alone have it. I doubt if any one would have divined that there are frontal horns only in this class; that those among them which have sharp canines for the most part lack horns.

However, since these relations are constant, they must have some sufficient cause; but since we are ignorant of it, we must make good the defect of the theory by means of observation. It enables us to establish empirical laws, which become almost as certain as rational laws, when they rest on sufficiently repeated observations; so that now, whoso sees merely the print of a cleft foot may conclude that the animal which left this impression ruminated, and this conclusion is as certain as any other in physics or morals. This footprint alone, then, yields to him who observes it, the form of the teeth, the form of the jaws, the form of the vertebræ, the form of all the bones of the legs, of the thighs, of the shoulders, and of the pelvis of the animal which has passed by. It is a surer mark than all those of Zadig."

The first perusal of these remarks would occasion surprise to some and immediately induce a second, more careful reading to ascertain whether they had not been misunderstood. Some men, with much less knowledge than either Cuvier or Huxley, may at once recall living exceptions to the positive statements as to the coordination of the "foot cleft" with the other characters specified. One of the most common of domesticated animals—the hog—would come up before the "mind's eye," if not the actual eye at the moment, to refute any such correlation as was claimed. Nevertheless, notwithstanding the fierce controversial literature centered on Huxley, no allusion appears to have been made to the lapsus. Yet every one will admit that the hog has the "foot cleft" as much as any ruminant, but the "form of the teeth" and the form of some vertebræ are quite different from those of the ruminants, and, of course, the multiple stomach and adaptation for rumination do not exist in the hog. That any one mammalogist should make such a slip is not very surprising, but that a second equally learned should follow in his steps is a singular psychological curiosity.

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[22] Ossemens fossiles, ed. 4^{me}, tome, 1^{r}, p. 184.

I need scarely add that the law of correlation applied by Cuvier to the structures of ruminants entirely fails in the case of many extinct mammals discovered since Cuvier's days. Zadig would have been completely nonplussed if he could have seen the imprint of an Agriochœrid, a Uintatherid or a Menodontid.

I have given this quotation for two reasons: first, to indicate how the increase of our knoweldge has revolutionized old conceptions; and second, to show how even the ablest of men may stumble.

Cope has been much criticised for the mistakes and false generalizations he made. Unquestionably he did make many. But error seems to be inseparable from investigation, and if he made more than the other great masters he covered more ground and did more work. He was also, it must be admitted, more hasty than some others in that he availed himself of the more frequent means of publication he enjoyed.

The great merit of Cope's work on mammals is that he always considered the old and new—the extinct and recent—forms together. He refused to be bound by consistency or by precedent, either set by himself or others. Fresh discoveries opened new vistas to him, and he modified his views from time to time and as often as he received new evidence.

He introduced many new families in the system and sought to improve the system by the comparison of all the elements of the skeleton. He came to the conclusion that the affinities of the ungulate quadrupeds were best expressed by the manner of articulation of the bones of the carpus and tarsus; he associated those having the "carpal and usually tarsal bones in linear series" in a great order which he called Taxeopoda, and contrasted them with the Proboscidea and typical Ungulata, which he named anew Diplarthra. In the Taxeopoda he gathered many extinct families and associated with them forms of the existing fauna known as the Hyracoidea, Daubentonioidea, Quadrumana and Anthropomorpha. I cannot altogether assent to this collocation inasmuch as I think the common characteristics of the three groups last mentioned—especially the structure of the brain and the development of the posterior cornua of the ventricles as well as calcarine sulci—justify the old order Primates. Nevertheless an important character was first appreciated in the composition of the podial bones, and fresh insight was obtained into the relations of ancient types.

I can only name a few more of Cope's discoveries in this connection. One was the generalization of "trituberculy," or the original development of three tubercles to molar teeth, and that subsequent modifications of the corresponding teeth were based on this original plan. Another was the remarkable *Phenacodus* of the Eocene, which was considered to be nearly in a line of descent for the Ungulates as well as the series culminating in man and which led him to the conception of the taxeopodous group.

The past history and genealogy of the Camels and their relations were likewise elucidated. In the present epoch only two nearly related types exist separated by half the globe—the true camels of central and northern Asia and the llamas of the Peruvian Andes. Cope revealed numerous species from various Tertiary beds and showed that the type was originally richly developed in America.[23]

VI.

Paleontology, from more than one point of view, may be divided into Invertebrata and Vertebrate. The subjects of the former are generally to be found in an approximately complete condition so far as the exterior is concerned, and early attracted the attention of investigators, often little familiar with recent zoology, and received names. The subjects of the latter—especially the higher types, as mammals, birds and reptiles—are rarely found, except in a fragmentary condition. Special knowledge of osteology, even to its minutest details, is requisite to successfully deal with such remains. Consequently the fossil vertebrates of the United States were neglected and left to the few who had cultivated the requisite knowledge to deal with them.

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[23] Prof. Osborn in a recent letter has justly remarked, that "in the mammals I hardly feel you do Cope sufficient justice, his work has been so potent." The exigencies of time and space alone prevented me from doing that justice, and I may remedy that defect later.

Another reason existed for the tardy attention to Vertebrate paleontology, which continued till nearly the last quarter of our present century in the United States. No deposits containing many fossil vertebrate remains had become known in the east. Zoologists interested in the past and in the genealogy of existing forms lamented the poverty of the United States, which contrasted with the richness of some parts of Europe. It was even thought that there was no hope of finding here such trophies of the past as the beds of the Paris Basin or those of Grecian Pikermi had yielded to European paleontologists. But all this was to be changed. Rumor had long before hinted that numerous skeletal remains could be found in certain parts of the wild west, but the information was very vague. Enough was known, however, to induce Professor Marsh to visit certain deposits of which he had heard. In 1870 he explored an Eocene lake-basin in Wyoming, drained by the Green River, the main tributary of the Colorado, and therein found numerous bones, belonging to almost all parts of the skeleton, of some remarkable gigantic mammals which he called Dinocerata. The results of this exploration interested Cope in the highest degree. He visited the same region in 1872, and thenceforth his attention to the Vertebrate paleontology of the western States and Territories was never interrupted. An intense rivalry arose between Professor Marsh and himself which, in time, it must be confessed, became very bitter. Nevertheless, as in most quarrels respecting facts, investigations were provoked by mutual recriminations which resulted in a more speedy accumulation of data and a more critical examination of those data than would have been likely under less perturbed conditions. Most of those data relate to morphological and anatomical considerations, and therefore belong rather to mammalogy and herpetology than to geology.

The relations of the ancient forms to each other in point of time; to those of other lands, and to those whose remains were imbedded in other rocks, had necessarily to be investigated. The earliest conclusions of Cope were brought together and published in 1879 in a memoir on "The Relations of the Horizons of Extinct Vertebrata of Europe and North America."[24] He attempted therein to synchronize, or rather, homotaxially correlate the various ancient faunas of North America and "West Europe" from the "Primordial" to the "Pliocene." Naturally the greater part of the memoir was devoted to the consideration of the Tertiary divisions; of these he admitted for the American faunas six primary divisions, and four of these were dichotomously subdivided. Of the primary divisions three were referred to the Eocene, one (White River) to the Oligocene, one (Loup Fork) to the Miocene, and one to the Pliocene. The exposition thus made represents views not very different from those now held, although, of course, modifications in details have since been necessary.

The evolution of the various animal, and especially mammalian types, were also continually the subject of Cope's researches, and he attempted to trace the passage from those of the most ancient periods to those of later ones.[25]

VII.

Cope was not satisfied with the study of morphological details or simple taxonomy. He aspired to know how animals came into existence; why they varied as they did, and what laws determined their being. His was an eminently philosophical mind, but at the same time with a decided tendency to metaphysical speculation. In one of his earliest papers he manifested this tendency and it persistod through life. It is with much hesitation that I venture to give an exposition of his most salient views, for I must confess I do not altogether like his philosophy and am able to subscribe to it only in part.

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[24] Bull. U. S. Survey Terr., V, 33–54.

[25] I have been reminded by Prof. Osborn of Cope's "discovery of the Puerco—Cope's greatest geological achievement—which Prof. Marsh still fails to recognize; also the definition of the John Day and Deep river beds," Prof. Osborn adds, that "practically the whole fauna of the Wasatch is also Cope's." I recognized these facts, but, as in herpetology and ichthyology, was obliged to limit my address and to refrain from going into details.

I cannot but wish that one of his numerous disciples could have been chosen for this task. But I must not pass it by, for it is the most characteristic feature of Cope's work and the one he most esteemed.

Cope began his public scientific career, it will be remembered, in the same year in which Darwin's long studies had fructified into his "Origin of Species."

As was quite natural with his keen instincts, Cope early adopted the doctrine of transmutation of species and recognized the truth that all the animals of the present epoch are descendents from those of past times with modifications which separate them as species, and eventually as representatives of genera, of families and orders differing from the earlier ones as we retrace the the steps of Time farther and farther back. He was not, however, satisfied with Darwin's theory, and denied that natural selection was a sufficient factor for differentiation. He would not admit that animals were passive subjects and that the slight variations which were manifested in the progeny of species were sufficient to enable Nature to select from and to fit for future conditions. He contended that the volition and endeavors of an animal had much to do with future progeny as well as its own brief life. In short, he claimed that characters acquired by animals through their own efforts or forced on them by various external agencies or accidents might be transmitted to their offspring. He further, first in a chapter in his "Synopsis of the Cyprinidæ of Pennsylvania," outlined, and later, in "The Origin of Genera," he elaborated, a peculiar theory characterized mainly by what he called (with Professor Hyatt) "the law of *acceleration* and *retardation* " in development. Darwin complained that he could never understand this law, and Cope complained that Darwin had not stated his views correctly in an attempted abstract. I therefore give Cope's views, restated in his own language, summarizing them years afterwards. "The following doctrines," he says, were taught:"

> First, that the development of new characters has been accomplished by an *acceleration* or *retardation* in the growth of the parts changed. This was demonstrated by reference to a class of facts, some of which were new, which gave ground for the establishment of the new doctrine.

Second, that of *exact parallelism* between the adult of one individual or set of individuals and a transitional stage of one or more other individuals. This doctrine is distinct from that of inexact parallelism which had already been stated by von Baer. And that this law expresses the origin of genera and higher groups, because,

Third, they can only be distinguished *by single characters* when all their representatives come to be known.

Fourth, that genera and various other groups have descended, not from a single generalized genus, etc., of the same group, but from corresponding genera of one or more other groups. This was called the doctrine of *homologous groups.*

Fifth, the doctrine that these homologous groups belong to different geological periods, and,

Sixth, to different geographical areas, which, therefore, in some instances, are,

Seventh, related to each other in a successional way like the epochs of geological time.

Of these doctrines it may be observed that the first and second are now the common property of evolutionists, and are recognized everywhere as matter of fact. The names which I selected to express them have, however, only come into partial use. The author believes that, although the doctrine was vaguely shadowed out in the minds of students prior to the publication of this essay, it had not previously been clearly expressed, nor been reduced to a demonstration. Of the truth of the doctrine the author is more than ever convinced, and he believes that paleontological discovery has demonstrated it in many instances, and that other demonstratious will follow. The fourth proposition (that of homologous groups) is now held as a hypothesis explaining the phylogeny of various groups of animals. For the descent of one homologous group from another, the term *polyphyletic* has been coined. It remains to be seen whether the doctrine is of universal application or not. That homologous groups belong to different geological horizons, as stated under the fifth head, has been frequently demonstrated sincs the publication of the essay. That the sixth proposition is true in a certain number of cases is well known, and it follows that the seventh proposition is also true in those cases. The latter hypothesss, which was originally advanced by Professor Agassiz, is, however, only partially true, and the advance of paleontological study has not demonstrated that it has had a very wide application in geological time.

A proposition which was made prominent in this essay was that the prevalence of non-adaptive characters in animals proves the inadequacy of hypotheses which ascribe the survival of types to their superior adaption to their environment. Numerous facts of this kind undoubtedly indicate little or no activity of a selective agency in nature, and do point to the existence of an especial developmental force acting by a direct influence on growth. The action on this force is the acceleration and retardation appealed to in this paper. The force itself was not distinguished until the publication of the essay entitled "The Method of Creation" [1871], where it was named growth-force or bathmism. The energetic action of this force accounts for the origin of characters, whether adaptive or non-adaptive, the former differing from the latter in an intelligent direction, which adapts them to the environment. The numerous adaptive characters of animals had by that time engaged the attention of the author, and he found that they are even more numerous than the non-adaptive. Some of the latter were accounted for on the theory of the "complementary location of growth-force.

We can only consider the "law of acceleration and retardation." Again it behooves us to seek his own definition:

a. The succession of construction of parts of a complex was originally a succession of identical repetitions; and grade influence merely determined the number and location of such repetitions.

b. Acceleration signifies addition to the number and location of such repetitions during the period preceding maturity, as compared with the preceding generation, and *retardation* signifies a reduction of the number of such repetitions during the same time.[26]

His meaning may best be inferred from his application to mankind. This was done in the following terms in 1872:[27]

Let an application be made to the origin of the human species. It is scarcely necessary to point out at the start the fact, universally admitted by anatomists, that man and monkeys belong to the same order of Mammalia, and differ in those minor characters, generally used to define a "family" in zoology.

Now, these differences are as follows: In man we have the large head with prominent forehead and short jaws; short canine teeth without interruption behind (above); short arms and thumb of hand not opposable. In monkeys we have the reverse of all these characters. But what do we see in young monkeys? A head and brain as large, relatively, as in many men, with jaws not more prominent than in some races; the arms not longer than in the long-armed races of men, that is, a little beyond half way along the femur. * * * At this age of the individual the distinctive characters are therefore those of *homo*, with the exception of the opposable thumb of the hind foot, and the longer canine tooth. * * *

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[26] Proc. Am. Phil. Soc., 1871; Origin of the Fittest, p. 182.

[27] Penn. Monthly Mag., 1872; Origin of the Fittest, p. 11, 1887.

Now, in the light of various cases observed, where members of the same species or brood are found at adult age to differ in the number of immature characters they possess, we may conclude that man originated in the following way: that is, by a delay or retardation of growth of the body and fore limbs as compared with the head; retardation of the jaws compared with the brain case, and retardation in the protrusion of the canine teeth.

There is a good reason for thinking that fallacy is involved in this argument, and that quite a different interpretation should be put on the evolution of charasters in question. It is not the fore limbs that are retarded in man, but the hind limbs have become enlarged (compare the adult and the infant). There is not retardation, of the jaws, but a special teleological adaptation. Man has, for the most part, at least, discontinued the use of his teeth for war-fare, and, as a result of diminished use, the canines have become reduced and the diastemata of the dental series obliterated. The brain has grown after birth and become enlarged, and, as a consequence, the brain case has extended forward—the reverse of what occurs in the apes. Concomitantly with the diminished use of the teeth and jaws, the masseter and temporal muscles have become reduced, and the sagittal and lambdoidal ridges have consequently become atrophied. The ecarinate rounded voluminous calvarium is the result.

It has been claimed that the young of higher species "are constantly accelerating their development." In man, however, development is retarded, inasmuch as infancy and juvenility are prolonged far beyond the periods observed in our simian relatives.

Such examples as this give cause to believe that the "law of acceleration and retardation" has been at least unduly extended. Acceleration and retardation are, however, to a large extent, terms which express facts of evolution; whether the word law is applicable may depend on the meaning one gives the word.

The transmission of acquired characters was one of the accepted and most cherished dogmas of Cope, and the belief in transmissibility of such characters is an essential of the ereed of so many who have become his followers in America that a special school came into existence known as the Neo-Lamarckian and also as the American School. My own prejudices have inclined me to that school. Nevertheless, when I have divested myself of such prejudices as well as I could, I have been compelled to admit that the evidence of the heredity of acquired characters was rather weak. There was, indeed, evidence for, as well as against, but that against the doctrine of the transmissibility of acquired characters seems to be the most weighty.

It is to be understood that the acquired characters considered in this connection are such as have been developed during post-natal life as a result of endeavors of the animal or of the influence of external agencies. The evidence presented has been mostly in support of the contention that the characters acquired have been directly inherited by offspring, and consequently the transition from the form not possessing the character to one having it is rapid. The evidence adduced has not been conclusive, to say the least. There is, apparently, a germ of truth in the proposition that acquired characters are transmitted, but in a modified sense, and the case has been weakened rather than strengthened by the evidence offered.

The evidence for inheritance of acquired characters was frequently given by Cope, and in his last published work—"The Primary Factors of Organic Evolution"—he marshalled the testimonies of many witnesses with his accustomed skill. He evoked "evidence from embryology," "evidence from paleontology," "evidence from breeding;" he considered the "characters due to nutrition," "characters due to exercise of function," "characters due to disease," "characters due to mutilation and injuries" and "characters due to regional influence;" he inquired into "the conditions of inheritance," and he fought against the "objections to the doctrine of inheritance of acquired characters." I have gone over all this evidence and yet I have not been convinced that the contention has been sustained that character acquired during the external life of an animal are transmitted. Many cases are alleged to sustain the "inheritance of characters due to mutilation and injuries." Some of these may be considered as mere coincidences; others provoke skepticism for one reason or other. To discuss them would be out of place here. But at least we may meet evidence with counter-evidence.

On the one hand, all the data and experiments recapitulated in the cases enumerated concern only two, or, at most, very few, generations of the animals in question, and were within the compass of a single man's life-time.

On the other hand, we have data and observations of the most reliable nature, and of an extraordinary compass. These have resulted not from experiments for the determination of a specific question, but from observances of a religious character. They were really in the nature of surgical operations, but for our purpose may be looked upon as experiments, and have the value of contrived experiments. In no other field has such a series of disinterested experiments been available. They were conducted on countless millions of mankind and for thousands of years. The subjects experimented upon were kept isolated from others alike by their own prejudices and the prejudices of their neighbors. Circumcision is the term applied to the experiments in question.

For about 4,000 years circumcision has been practiced on a gigantic scale. Every male child among the Jews was operated upon, not only in Palestine, but wherever representatives of the race had wandered and adhered to their religion; religion itself was involved in the operation and it was regarded as a holy rite; the most scrupulous attention was paid to details. The operation was performed eight days after birth, and consequently there could be no functional activity of the tissues concerned. But after 4,000 years the new-born boys of the race come into the world with the special integument developed as much as in those of other races. Even the princiciple of atrophy through disuse has not become manifest in the case.

Other evidence, it seems to me, is the result of confounding the potentiality of a function with its manifestation. I allude to one set of examples on account of the interest of the cases, and I do so with the deference due to the eminence and ability of the gentleman who has furnished the evidence. That evidence has been collected under the head of "inheritance of characters due to the exercise of function." The evolution of the American trotting-horse was considered. It was recorded that "by 1810 the taste for trotting as a sport had * * * increased here, and in 1818 it became a recognized sport under specific rules." * * * "At the end of 1824, six years after the first accepted three-minute record, the record had fallen to 2:34." * * * "By 1848 the record was lowered to 2:29½; the next decade lowered the record five seconds." Finally, at the close of 1895, the record had been further lowered to 2:03¾. * * * It is deduced from these premises that "there is nothing whatever in the actual phenomena observed anywhere along the line of this development of speed that would lead us to even suspect that the changes due to exercise of function had *not* been a factor in the evolution." But to me it seems that there is no evidence to show that the speed attained was other than would have resulted from taking the same animals untrained and then speeding the last. The speed is, of course, simply the expression of functional adaption, and the horses were selected merely because, by their manifestation, they showed that they had the co-ordination of structural and psychological characters needed for the manifestation of the function. The manifestation guided the breeder to the selection of the animals. The successful animals were the pick of thousands unknown to fame.

But there is much in the history of the development of animals that seems to lead to the belief that eventually modifications may be due in part to acts of representatives of the phylum to which they belong. It is difficult to believe that some structural features are simply the result of natural selection operating on chance variations. An application of the doctrine of chances to some such cases appears to be adverse to the conception that they represent the influence of natural selection unaided.

A feature characteristic of most cave animals of widely diverse groups and classes is the atrophy of the eyes, and it seems to be most logical to attribute this to disuse of those organs in remote progenitors, and to assume that the atrophy may have resulted from a failure of nourishment by the nutrient fluid of the organs on account of the loss of functional activity rather than to selection by nature of forms with successively diminishing eyes. The presence of eyes in most cases certainly would scarcely be an element of disadvantage to animals, and it may be allowable to invoke some other agency than chance selection. We may be justified in postulating that the continuous disuse of the organs would in time react on the nutrition of the parts affected, and finally atrophy or disappearance would result. Like explanation would be applicable to the innumerable cases of atrophy of parts known to the naturalist.

But if cessation of nutrition culminates in final atrophy, increased nutrition of parts may result in hypertrophy and increased nutrition may be the concomitant of increased activity of parts. The exercise of such parts continued for many generations may react on the organization and the progeny at length be affected thereby. Of such cases Cope adduced many examples. The feet of the horse line furnish illustrations. The existing horse has the median toes and hoofs greatly hypertrophied and the lateral ones atrophied, but the remote ancestors had feet of nearly the same general pattern as the rhinoceroses and tapirs. Atrophy of the lateral digits has progressed inversely to hypertrophy of the middle ones. An analogous line of development culminating in feet superficially much like those of the horse was followed by another quite remote family of hoofed mammals, the Prototheriids of South America.

The idea of acceleration and retardation was associated by Cope with the idea that the course of evolution was determined from the beginning of things, and that life, to use his own words, is "*energy directed by sensibility or by a mechanism which has originated under the direction of sensibility.*" He maintained that "consciousness as well as life preceded organism," and he called this conception "the hypothesis of archæsthetism." This idea I refer to especially because it was broached in his vice-presidential address, delivered at the meeting of the American

Association for the Advancement of Science, in Philadelphia, in 1884.[28]

I am, myself, unable to comprehend consciousness except as a product or result of organization, and those who wish to learn more about Cope's views respecting the question must refer to one of his many papers.

Whatever may be thought of Cope's philosophical views, his presentation of them is always interesting, and some of them are illustrated with a wealth of facts that renders his communications valuable as repertories of well digested information. His first special paper, on "The Origin of Genera," published as early as 1868, is especially noteworthy for the mass of morphological data contained in it, and for the apt manner in which they are tabulated.

VIII.

I venture to conclude with some reflections on the rank that may be assigned to Cope in the world of science.

Among those that have cultivated the same branches of science that he did—the study of the recent as well as the extinct Vertebrates—three naturalists have acquired unusual celebrity. Those are Cuvier, Owen and Huxley.

Cuvier excelled all of his time in the extent of his knowledge of the anatomical structure of animals and appreciation of morphological details, and first systematically applied them to and combined them with the remains of extinct Vertebrates, especially the mammals and reptiles. He was the real founder of Vertebrate paleontology.

Owen, a disciple of Cuvier, followed in his footsteps, and, with not unequal skill in reconstruction and with command of ampler materials, built largely on the structure that Cuvier had begun.

Huxley covered as wide a field as Cuvier and Owen, and likewise combined knowledge of the details of structure of the recent forms with acquaintance with the ancient ones. His actual investigations were, however, less in amount than those of either his predecessors. He excelled in logical and forcible presentation of facts.

[28] **Origin of Fittest, p. 425.**

Cope covered a field as extensive as any of the three. His knowledge of structural details of all the classes of Vertebrates was probably more symmetrical than that of any of those with whom he is compared; his command of material was greater than that of any of the others; his industry was equal to Owen's; in the clearness of his conceptions he was equalled by Huxley alone; in the skill with which he weighed discovered facts, in the aptness of his presentation of those facts, and in the lucid methods by which the labor of the student was saved and the conception of the numerous propositions facilitated, he was unequalled. His logical ability may have been less than than that of Huxley and possibly of Cuvier. He has been much blamed on account of the constant changes of his views and because he was inconsistent. Unquestionably he did change his views very often. Doubtless some of those changes were necessitated by too great haste in formulation and too great rashness in publication. The freedom to change which he exercised, and which was exercised too little by at least one of his predecessors, was an offset to his rashness. He exercised a proper scientific spirit in refusing to be always consistent at the expense of truth.

His reputation at present is much inferior, at least among the people at large, to those of the men with whom he has been compared. Immediate reputation depends on various circumstances, some of which are quite adventitious, and it is often long before men find their true levels. It is scarcely premature to prophesy that Cope's reputation will grow and that in the future history of science his place will be at least as large as that of any of his predecessors.

NEW OBSERVATIONS ON THE ORIGIN OF THE GALÁPAGOS ISLANDS, WITH REMARKS ON THE GEOLOGICAL AGE OF THE PACIFIC OCEAN.

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No. II.

THE GEOGRAPHICAL DISTRIBUTION OF DIFFERENT ANIMALS IN THE PACIFIC AND INDO-PACIFIC OCEANS.

We will now examine the distribution of a number of animals in the Pacific, in order to find out how this distribution agrees with the theories of the origin of this Ocean.

Ortmann[28] has shown that there is a uniform Indo-pacific Litoral Region.

Distribution of Pocillopora Lam.

Pocillopora,[29] a coral of the Madreporaria, is found only in the Indo-pacific region. It is represented by an extraordinary large number of forms reaching north to the Loo Choo and Sandwich Islands, and it is also common on the west coast of America. It is totally absent, however, from the Caribbean or West Indian Sea and the eastern American coral region. A few fossil forms are known since the miocene, *Pocillopora madreporacea* (Lam.), from Dax and Turin.

It is of the highest interest, that the members of the Decapod Family Trapeziidæ[30] shows exactly the same distribution as Pocillopora. I am greatly obliged to my friend Dr. Ortmann for calling my attention to this fact. In his recent paper on the geographical distribution of the Trapeziidæ, he makes the following remarks: "It is a very important fact, that all the members of this family are limited to an exceedingly peculiar habitat, the coral reefs; only a single species, *Quadrella coronata*, is said to occur between pearl-shells in the Panama Bay; but this case is certainly an exceptional one. All the other species are known from coral reefs. The Trapeziidæ are especially inhabitants of *living* corals, and live between the network of their fine branches. This mode of life characterizes them as typical littoral forms, which are found from the tidal zone to the same approximate depth to which the corals reach; the greatest depth mentioned is 22 fathoms in *Trapezia cymodoce* (Herbst)."

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[28] Ortmann, Arnold E. Grundzüge der marinen Thiergeographie. Jena, 1896.

[29] Ortmann, A. Studien über Systematik und geographische Verbreitung der Steinkorallen. Zoolog. Jahrb. Abtheil. f. System., II, Band, p. 143-188, Tafel VI, 1888.

[30] Ortmann, Arnold E. Die geographische Verbreitung der Decapoden Familie Trapeziidæ. Zool. Jahrb., Abth. f. System., X, Band, p. 201-216, 1897.

I shall now give the geographical distribution of the Trapeziidæ from Ortmann.

Geographical Distribution of the Decapod Family Trapeziidæ.

Trapezia Latreille 1825.

1. *Trapezia cymodoce* (Herbst) 1801.

Distribution: Probably everywhere in the Indo-Pacific littoral region, where coral reefs are found, from tide mark to 22 fathoms; Red Sea; East Africa: Dar-es Salaam; Glorioso, Amirante Islands, Seychelles; Maledives; Southern India; Ceylon; Mergui Islands; Singapore; Java; Borneo; Philippines; Loo Choo Islands; Moluccas; New Guinea; Queens land; New Caledonia; Fiji Islands; Tongatabu; Tahiti; Marquesas Islands.

2a. *Trapezia ferruginea dentata* (Macleay), 1838.

Distribution: Sulu Islands; Pelew Islands; Fiji Islands; Tongatabu; Samoa Islands; Tahiti; Paumatu Islands.

2b. *Trapezia ferruginea* Latreille, 1825.

Distribution: Red Sea; Zanzibar; Mauritius; Seychelles; Ceylon; New Caledonia; Samoa; Tahiti; Marquesas; Sandwich Islands; Panama Bay: Pearl Islands; Acapulco.

2c. *Trapezia ferruginea guttata* Rüppel, 1830.

Distribution: Red Sea; Seychelles; Loo Choo; Fiji; Samoa Islands; Tahiti.

2d. *Trapezia ferruginea maculata* (Macleay), 1838.

Distribution: Red Sea; Zanzibar; Glorioso Group and Amirantes; Rodriguez; Ceylon; New Caledonia; Samoa; Tahiti; Sandwich Islands; west coast of Mexico: Socorro Islands.

2e. *Trapezia ferruginea areolata* Dana, 1852.

Distribution: Ceylon; Nicobares; Java; Celebes; Amboina; Sulu Sea; Loo Choo Islands; New Caledonia; Fiji; Samoa Islands; Tahiti.

3a. *Trapezia rufopunctata* (Herbst), 1799.

Distribution: East Africa: Dar-es-Salaam; Ceylon; Tuticorin; Java; Philippines: Samboangan; Amboina; Samoa; Tahiti; Marquesas; Sandwich Islands.

3b. *Trapezia rufopunctata flavopunctata* Eydoux et Souleyet, 1841.

Distribution: Mauritius; New Caledonia; Tahiti; Sandwich Islands.

4a. *Trapezia digitalis* Latreille, 1825.

Distribution: Red Sea; Mauritius; Marquesas Islands; west coast of Central America; Panama Bay; Pearl Islands: Veragua; Cape St. Lucas.

4b. *Trapezia digitalis speciosa* Dana, 1852.

Distribution: Mauritius; Paumotu Islands.

4c. *Trapezia digitalis bella* Dana, 1852.

Distribution: Paumotu Islands.

Tetralia Dana, 1852.

1. *Tetralia glaberrima* (Herbst), 1790.

Distribution: Red Sea; Zanzibar; Dar-es-Salaam; Ibo; Natal; Madagascar; Nossi Bé; Rodriguez; Amirantes; Seychelles; Southern India; Java; Hong Kong; Loo Choo Islands; Amboina; New Caledonia; Fiji; Tongatabu; Tahiti; Paumotu; Marquesas Islands.

Quadrella Dana, 1852.

1. *Quadrella coronata* Dana, 1852.

Distribution: Indian Ocean; Providence Island; Sulu Sea; Panama Bay: Pearl Islands, between pearl shells.

Ortmann makes the following remarks: "The distribution of the Trapeziidæ is very simple but characteristic, and agrees very well with the limitations of the modern geographical regions of animals. Wherever in the whole Indo-Pacific area coral reefs are found, there are also *Trapeziidæ.* Most of the species and subspecies extend over the whole Indo-Pacific region, from the Red Sea and East Africa to the Loo Choo and Sandwich Islands, to Queensland in Australia and to the Paumotu Islands [and even the west coast of Central America]. Some forms, according to the present data, seem to be a little more limited, for instance, *Trapezia ferruginea dentata* has not yet been recorded from the Indian, but is found from the Sulu Sea eastwards; *Trapezia ferruginea areolata* is known eastward from Ceylon; *Trapezia digitalis bella* only from the Paumatu Archipelago. It is quite possible, however, that these forms will be discovered later in those places where they at present have not yet been found. Some species (*Trapezia digitata speciosa* and *Quadrella coronata*) have been found only in few isolated places, but these places are so far distant from each other, that we can assume with certainty their general distribution, even if they might be rare forms.

At the west coast of America it is not possible to distinguish any well characterized peculiar species; the four species mentioned from this region are also found in the Indo-Pacific region. Therefore, we must conclude, that the west American Region received these species from the Indo-Pacific. How these forms were able to pass the barrier of the open Pacific Ocean, can only be guessed. Migration along the North Pacific shore line is impossible, the Trapeziidæ being exclusively tropical forms; the conditions of former geological times can not be considered, since this family, as will be seen immediately, is of very recent age. Only one supposition remains, that the *Trapeziidæ* possess means of migration in free swimming planctonic larvæ, which enable them to reach inside the tropics, the western coast of America from the Pacific Islands. This, however, remains a simple supposition; we know nothing whatever about the propagation and development of the *Trapeziidæ* and about their eventual larvæ."

Ortmann believes that this is also the reason why so few forms of the Trapeziidæ are found in the West American region. After this he makes some very important remarks about the geological age of the Trapeziidæ.

"The distribution of the Trapeziidæ also demonstrates an important fact, which is of significance for the consideration of the geological age of this family. While represented on the western side of America, it is *totally* absent from the eastern side, especially in the West Indian Seas, so rich in corals. This fact is to be considered still the more, since the West and East American littoral regions show considerable relationship. This resemblance, however, must be explained by the former history of the American seas; that is, the well known and generally accepted union between the Caribbean Sea and the Pacific Ocean, which existed in the middle of tertiary time. The fact that the *Trapeziidæ* were unable to migrate into the Caribbean Sea, indicates that the land connection between North and South America was already finished during the time of their origin or their immigration into the West American littoral region, preventing their further eastern advance. From this reason we have to consider the Trapeziidæ as a relatively young family, which can not be older than the formation of this land barrier; that is, not older than Middle Tertiary (Miocene), but possibly still younger.

"Especially the Trapeziidæ indirectly prove that the relations between the tropical West Indian and tropical Indo-Pacific faunas can only be explained by a connection in *former* times, which does no longer exist, for they demonstrate that a group of animals, arising in the Indo-Pacific region after its isolation in its present form, and which seems to have the power to pass over extensive areas of the sea, was unable to reach the eastern American region. The Trapeziidæ could pass the barrier of the open Pacific and thus reach the western coast of America, but they could not enter the Atlantic Ocean; on one side they were prevented by the Isthmus of Central America, on the other side they could not pass the southern point of Africa, which is doubtless caused by the prevailing conditions of temperature in that region."

The general distribution of Pocillopora and the Trapeziidæ in the Indo-Pacific region, can only be explained by a former land connection of this region. Let us suppose for one moment that the Pacific Islands had been elevated gradually by volcanic activity, how was it possible that Pocillopora and at the same time the Trapeziidæ reached all these islands? There were no corals or Trapeziidæ near these islands which were elevated from the oçean. If we consider the Pacific Islands as the remains of a former Pacific continent, we have no difficulty whatever in explaining the general distribution of Pocillophora and the Trapeziidæ. Both are of recent origin (miocene) and demonstrate that the Pacific continent must have still existed just before this time. I have shown that the Galápagos Islands were separated from Central America during the miocene, and the geology of the Fiji Islands shows that the first sedimentary strata are also miocene.

We may now examine the distribution of a family of Decapods, the *Atyidæ,* which is confined to the fresh-water.[31]

Geographical Distribution of the Decapod Family Atyidæ Kingsley.

ATYIDÆ.

Hiphocaris v. Martens, 1872.

1. *Hiphocaris elongata* (Guèrin), 1857.

Distribution: Fresh-waters of the Antilles; Cuba; Hayti; Dominica; San Domingo.

2. *Hiphocaris compressa* (de Haan), 1849.

Distribution: Fresh-water of Australasia; Japan: Yokohama, Tokio; Island of Adenare, near Flores; Queensland: Burnett.

Troglocaris Dormitzer, 1853.

1. *Troglocaris schmidti* Dormitzer, 1853.

Distribution: In the waters of the caves of Carniola; caves of Kumpole and Gurk (Dormitzer).

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[31] Ortmann, Arnold E. A Study of the Systematic and Geographical Distribution of the Decapod Family Atyidæ Kingsley. Proc. Acad. Nat. Sci. Phila., 1894, p. 397–416.

Atyaëphyra Brito-Capello, 1866.

1. *Atyaëphira desmarestii* (Millet), 1832.
Distribution: Fresh-water of southern Europe.—Portugal: Coimbra; Southern and Western France; Corsica; Sicily; Dalmatia.

Caridina Milne-Edwards, 1837.

1. *Caridina typus* Milne-Edwards, 1837.
Distribution: Fresh-water of the islands of the Indian Ocean and of Indo-Malayasia; Mauritius; Rodriguez; Seychelles; Siam; Flores; Timor; Saleyer; Celebes; Amboina; Loo Choo.

2. *Caridina americana* Guèrin, 1857.
Distribution: Cuba; Dominica.

3. *Cardinia brevicarpalis* de Man, 1892.
Distribution: Celebes; Amboina.

4. *Cardinia weberi* de Man, 1892.
Distribution: Sumatra; Java; Saleyer; Celebes; Flores.

5 *Cardinia japonica* de Man, 1892.
Distribution: Japan: Kagar, Hayagana.

6. *Cardinia pareparensis* de Man, 1892.
Distribution: Celebes.

7. *Cardinia timarensis* de Man, 1893.
Distribution: Timor.

8. *Cardinia parvirostris* de Man, 1892.
Distribution: Flores.

9. *Cardinia richtersi* Thallwitz, 1891.
Distribution: Mauritius.

10. *Caridina laevis* Heller, 1862.
Distribution: Java.

11. *Caridina multidentata* Stimpson, 1860.
Distribution: Bonin Island; Celebes.

12. *Caridina africana* Kingsley, 1882.
Distribution: S. Africa: Zulu Land.

13. *Caridina fonarum* Heller, 1867.
Distribution: Persia: Schiraz.

14. *Caridina serratirostris* de Man, 1892.
Distribution: Flores; Saleyer; Celebes.

15. *Caridina wycki* (Hickson), 1888.

Distribution: From East Africa to Eastern Australia.—East Africa; Dar-es-Salaam; Ceylon; Celebes; Saleyer; Flores; Timor; Queensland: Burnett.

16. *Caridina nilotica* (Roux), 1833.

Distribution: Northern Africa; Nile; Algiers; River Macta near Oran.

17. *Caridina grandirostris* Stimpson, 1860.

Distribution: Loo Choo Islands.

18. *Caridina gracilirostris* de Man, 1892.

Distribution: Sumatra; Celebes; Saleyer; Flores.

19. *Caridina singhalensis* Ortmann, 1894.

Distribution: Ceylon.

20. *Caridina brevirostris* Stimpson, 1860.

Distribution: Loo Choo.

21. *Caridina pasadenæ* Kingsley, 1896.*

Distribution: Southern California.

Atyoida Randall, 1839.

1. *Atyoida potimirim* F. Müller, 1881.

Distribution: Brazil: Itajahy.

2. *Atyoida bisulcata* Randall, 1839.

Distribution: Hawaiian Islands; Oahn; Tahiti.

Atya Leach, 1817.

1. *Atya moluccensis* de Haan, 1849.

Distribution: Fresh-water of the Indian Archipelago; Sumatra; Java; Batjan; Bali; Celebes; Saleyer; Ceram; Timor; Flores; Amboina; Philippine Islands: Samar.

2. *Atya spinipes* Newport, 1847.

Distribution: *This species represents A. molluccensis in the fresh-water of the Pacific Islands;* Philippine Islands; Caroline, Fiji, Samoa Islands.

3. *Atya brevirostris* de Man, 1892.

Distribution: Flores; Timor; Amboina.

?4. *Atya margaritacea* A. Milne-Edwards, 1864.

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* **Added by Prof. Kingsley.**

Distribution: New Caledonia.

?5. *Atya robusta* A. Milne-Edwards, 1864.

Distribution: New Caledonia.

6. *Atya scabra* Leach, 1815.

Distribution: Fresh-water of Central America and the West Indies and the Cape Verde Islands.—Mexico; Nicaragua; Cuba; Hayti; Jamaica; Dominica; Martinique; Tobago.—Cape Verde Islands; San Nicolao; San Jagoo.

7. *Atya gabonensis* Giebel, 1875.

Distribution: Gaboon; Orinoco.

8. *Atya crassa* Smith, 1871.

Distribution: Nicaragua; Mexico: Presidio.

I have to thank my friend, Dr. Ortmann, for calling my attention to this paper. I make the following quotations from it: "*Some species of Atyidæ were formerly considered to be marine animals; there is now no doubt that this family contains only fresh-water forms. This family is probably one of the most primitive groups of Decapods living in fresh-water, having immigrated at an early geological period.*" (Italics are mine).

"The geographical range of the Atyidæ embraces the whole of the circum-tropical parts of the world, members of the family being recorded from all the localities explored within these limits. Only in two localities does the range exceed the true tropics; in Japan, where it extends as far north as Tokio, and in the Mediterranean province, where it extends northward to Southern France and Southern Austria." The description by Kingsley of *Caradina pasadenæ* from Pasadena, California, since Ortmann wrote these words hardly makes necessary a modification in them, for Southern California is sub-tropical in its temperature. (Kingsley).

"The most primitive genus, Hiphocaris, shows a distribution the peculiarity of which can only be understood by supposing that the range of this genus was formerly a more extended one, but that in most parts of the world the representatives were exterminated. Only three species survived, one of which lives now in the fresh-waters of the West Indies, the other in Indo-Malaysia, from Japan to Australia, and the third in New Zealand. The closely allied genus Troglocaris, the only species of which might be regarded as a fourth form of Xiphocaris, lives in the subterranean waters of Carinola, a perfectly isolated locality in no way connected with the others named. The third primitive genus, Atyaëphyra, is found near the locality of Troglocaris on the northern borders of the Mediterranean Sea. The scattered localities at which are found the species of these three genera forming the subfamily Xiphocarinæ are no doubt the remains of a more universal distribution in former times; the species now living show the character of true survivals."

"In the subfamily Atyinæ, the genus Atyoida shows a survival character similar to that of the Xiphocarinæ, being recorded from the Sandwich Islands, Tahiti and Southern Brazil."

"The genus Caridina appears to be nearly a circumtropical one. Its range is divided into two very unequal parts; the one comprising the West Indies [and California] and containing only one [two] species, the other comprising a continuous area of the Old World and containing at least nineteen other species. This area extends from South Africa along the east coast to the southern borders of the Mediterranean Sea and to Persia, crossing the islands of the Indian Ocean and Indo-Malaysia to Japan and Australia. It is very probable that further investigations will prove that the range of *Caridina* is a somewhat different one, since fresh-water crustacea of smaller size are mostly neglected by collectors, and the fauna of the fresh-waters of most tropical countries are very little known."

"The distribution of the most extreme genus of the family Atya is somewhat similar to that of Caridina. It is found, like the latter, in the West Indies and Indo-Malaysia, but there are some modifications. One species is known from West Africa, which is identical with another described from the Orinoco, and there is recorded one species from the Cape Verde Islands, identical with the common West Indian form." "The other range of the genus Atya extends over the islands of the Pacific from Sumatra to the Samoan Islands" [and western Central America].

"The conditions of geographical distribution of the Atyidæ are as follows:—

1. The Atyidæ can not endure cooler climates (*climatic barriers*).
2. They are true fresh-water animals (oceans and tracts of land without water form *topographic barriers*).
3. Being animals of an ancient type, they are probably restricted by the occurrence of other fresh-water animals (*bronomic barriers*).
4. The faculties of distribution aré very limited.

The Atyidæ are, therefore, confined to the fresh-waters of the tropics and subtropics; the distribution of the genera and species, especially of the more primitive ones, shows a remarkable character of survival. Only Caridina and Atya are of a more recent character, extending over continuous areas within the tropics. Because of the antiquity of the family it has no relations among the recent forms of the littoral regions of the tropical seas."

The following conclusions can be drawn from the distribution of the Atyidæ. The distribution of Cardinia shows that there must have existed a land connection between Africa, the Mascaren Islands, the Seychelles, Persia, Ceylon, the Sunda Islands, the Mollucas, Siam, the Loo Choo Islands, Japan and the Bonin Islands, and between the Mollucas and Australia.

The distribution of Atya shows that this land area extended over the Philippine, Caroline, Fiji and Samoa Islands, and the presence of *Atyoida bisulcata* on the Society and Sandwich Islands, proves that this land extended also to these islands and probably also to the west coast of America (*Atya scabra* Mexico, *Nicaragua* Baur). The presence of *Cardinia paredena* Kingsley, in Lower California is another proof of this connection. The presence of *Atya scabra* on the Cape Verde Islands, and of *Atya gabonensis* in Gaboon and the Orinoco, can only be explained by a former connection of Africa and America (Ortmann).

Geographical Distribution of the Formicidæ of the Pacific Ocean.

The Formicidæ are a very old group. Their first remains have been found in the lowest Jurassic: *Palæomyrmex prodromus* Heer,[32] Lower Lias of Schamblen, Canton Aargau, Switzerland. In the lower Purbeck of Durdlestone Bay, England occur *Formicium brodiei* Westwood, and *Myrmecium heeri* Westwood,[33] and several forms have been described from the Kimmeridgean of Solnhofen, Bavaria. Very rich are the Amber-Beds of the lower Oligocene of the Samland,[34] north of Königsberg, and the well-known Florissant Beds of Colorado. Scudder remarks, that about one-fourth of all the Insects from Florissant are ants, more than 4000 specimens, representing 34 genera and 170 fossil species. Among Miocene localities may be named Oeningen in Baden, and Radoboj in Croatia.[35]

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[32] Heer O. Die Urwelt der Schweiz. Zürich., 1865, p. 91.

I now give a list of the distribution of the *Formicidæ* of the Pacific Ocean, from Ihering,[36] with some additions from Emery[37] and Smith.[38] Many of the additional localities have been kindly supplied by Mr. Theo. Pergande of the Department of Agriculture, Washington.

Family FORMICIDÆ,

Subfamily: *Ponerinæ* Mayr.

1. *Ponera insulana* Mayr. Samoa.
2. *Ponera* sp. aff. *contracta* Latr. Sandwich Islands.
3. *Ponera castanea* Mayr. New Zealand.

1. *Ectatomma metallicum* Smith. Samoa, Australia.
2. *Ectatomma mayri* Emery. New Zealand (or Australia?).
3. *Ectatomma brownii* Forel. New Zealand.

1. *Amblypone cephalotes* Smith. New Zealand.
2. *Amblypone saundersii* Forel. New Zealand.

1. *Leptogenys insularis* Smith. Sandwich Islands.

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[33] Westwood J. O. Contributions to fossil entomology. Quart. Journ. Geol. Soc. X, pp. 388, 393, 390, 396, 1854.

[34] Mayr. Gustav Leopold. Die Ameisen des Baltischen Bernsteins. Mit 106, Figuren auf. 5 Tafeln. (Beiträge z. Naturkunde Preussens I), pp. 4, 102, (10), tab. 5. 4° Königsberg, 1868.

[35] Mayr. Gustav Leopold. Vorläufige Studien über die Radoboj-Formiciden Jahrbuch d. k. k. geolog. Reichs-Anstalt, Bd. XVII, p. 47–62, Taf. I, 1867.

[36] Ihering, H. von. Die Ameisen von Rio Grande Sul. Berliner Entom. Zeitschr. Bd. XXXIX, pp. 434–436, 1894.

[37] Emery, C. Notice sur quelques Fourmis des îles Galapagos. Ann. Soc. Entom. France, vol. LXII, p. 89–92, 1893.

[38] Smith, Fred. [Hymenoptera Galapagos]. Proc. Zool. Soc., p. 83, 1877.

1. *Odontomachus hæmatodes* Linn. Tonga, Samoa, Fiji, Borneo, Java, Celebes, Ceylon, Amboina, Australia, Guiana, Columbia, Mexico, Texas, Florida.

2. *Odontomachus angulatus* Mayr. Fiji Islands.

3. *Odontomachus bauri* Emery. Galápagos Islands.

1. *Anochetus græffei* Mayr. Samoa.

Subfamily: *Myrmicinæ* Mayr.

1. *Strumigenis antarctica* Forel. New Zealand.

2. *Strumigenis godeffroyi* Mayr. Samoa.

1. *Orectognathus antennatus* Smith. New Zealand.

2. *Orectagnathus perplexus* Smith. New Zealand.

1. *Monomorium pharaonis* Linn. Samoa, Australia, Chile, La Plata, India, Singapore, Batavia, Manilla, Ceylon, Brazil, Eastern and Southern States, N. A., Egypt, Cape Colony, Italy, France, South Germany, England.

2. *Monomorium speculare* Mayr. Samoa, Tonga, Borneo, India.

3. *Monomorium antarctium* White. New Zealand.

4. *Monomorium suteri* Forel. New Zealand.

5. *Monomorium smithii* Forel. New Zealand.

1. *Cardiocondyla nuda* Mayr. Fiji, Samoa, Tonga, India.

1. *Tetramorium pacificum* Mayr. Tonga, Samoa.

2. *Tetramorium simillimum* Smith. Samoa, Java.

3. *Tetramorium tonganum* Mayr. Tonga.

4. *Tetramorium guineense* Fabr. Fiji, Tonga, Sandwich Is., Galápagos Island, Manilla, Sidney, Madagascar, Cuba, S. Domingo, California.

1. *Vollenhovia samœnsis* Mayr. Samoa.

1. *Huberia striata* Smith. New Zealand.

1. *Solenopsis geminata* Fabr. New Zealand, Tahiti, Sandwich Islands, Chile, La Plata, Brazil.

1. *Pheidole megacephala* Fabr. Sandwich Islands, Ceylon, Madeira, Bahamas, Brazil.

2. *Pheidole sexspinosa* Mayr. Samoa, Ellice Islands.

3. *Pheidole umbonata* Mayr. Samoa, Tonga Islands.

4. *Pheidole oceanica* Mayr. Samoa, Tonga, Ellice Islands.

Subfamily *Dolichoderinæ*.

1. *Tapinoma melanocephala* Fabr. Samoa, Tonga, Galápagos Islands, Singapore, Cayenne, West Indies, Madagascar.

1. *Plagiolepis gracilipes* Smith. India, Singapore, Celebes, China, Australia, Samoa, Tonga, Ellice Islands, Chili.

1. *Technomyrmex albipes* Smith. Ceylon, Sunda Islands, Samoa, Tonga, India, Hong Kong, Papua.

1. *Tridomyrmex gracilis* Lowne. Samoa, Australia.

2. *Tridomyrmex rufoniger* Lowne. Samoa, Australia.

Subfamily *Camponotinæ* Forel.

1. *Camponotus novæ-hollandiæ* Mayr. Australia, Samoa, Tonga, Ellice Islands.

2. *Camponotus cristatus* Mayr. Fiji Islands.

3. *Camponotus laminatus* Mayr. Fiji Islands.

4. *Camponotus schmeltzi* Mayr. Fiji Islands.

5. *Camponotus sexguttatus* Fabr. Sandwich Islands, South America, Island of Santa Cruz, West Indies, Canary Islands.

6. *Camponotus pallens* Guill. Tonga Islands.

7. *Camponotus pallidus* Smith. Fiji, Tonga, Samoa Islands.

8. *Camponotus subtilis* Smith. Fiji Islands.

9. *Camponotus senex* Smith. Galápagos Islands, Brazil, Central America, Mexico.

10. *Camponotus planus* Smith. Galápagos Islands.

11. *Camponotus macilentus* Smith. Galápagos Islands.

12. *Camponotus peregrinus* Emery. Galápagos Islands.

1. *Colobopsis dentata* Mayr. Fiji Islands.

2. *Colobopsis carinata* Mayr. Fiji Islands.

3. *Colobopsis oceanica* Mayr. Fiji Islands.

4. *Colobopsis nigrifrons* Mayr. Tonga Islands.

5. *Colobopsis conica* Mayr. Tonga Islands.

6. *Colobopsis rufifrous* Smith. Tonga, Fiji, Molluccan Islands.

1. *Prenolepis vividula* Nyl. Tonga, Samoa, Ellice Islands, Australia, Madagascar, Texas.

2. *Prenolepis longicornis* Latr. Samoa, Chile, Senegal, N. America, Batavia, Ceylon, Mexico, Cuba, Madeira.

3. *Prenolepis clandestina* Mayr. Sandwich Islands, Java.

I have very little doubt, that on many groups of Islands, on which, so far as I know, no Formicidæ have been recorded, they will be found, when these Archipelagos will be thoroughly examined; for instance the Pelew and Marianne Islands, the Carolines, the New Hebrides, the Cook, Paumatou, Marquesas and Juan Fernandez.

It is quite evident, that this distribution of the *Formicidæ* cannot be explained by accidental introduction. Also here we are forced to accept a former Pacific Continent.

The *Fiji Islands* have four endemic species of *Camponotus; three* of *Colobopsis;* one of *Odontomachus;* the *Tonga Islands* one endemic species of *Camponotus;* two of *Colobopsis,* one of *Tetramorium;* the *Samoa Islands,* one endemic species of *Anochetus,* one of *Strumigenys* and one of *Vollenhovia;* the *Sandwich Islands* one endemic species of *Ponera,* and one of *Leptogenys;* the *Galapagos Islands* three endemic species of *Camponotus,* and one of *Odontomachus.*

The Fiji, Tonga and Samoa Islands have in common one species of *Camponotus* and one of *Cardiocondyla* (also found in India); the Samoa, Tonga, Ellice Islands and Australia one *Camponotus;* the Fiji, Tonga, Moluccan Islands, one *Colobopsis;* the Sandwich Islands and Java, one *Prenolepis;* Samoa and Australia, two *Tridomyrmex,* one *Ectatomma;* Samoa and Java, one *Tetramorium;* Samoa and Ellice Islands, one *Pheidole;* Samoa and Tonga Islands, one *Pheidole* and one *Tetramorium;* Samoa, Tonga, Sunda Islands, Ceylon, Indi , Hong Kong, Papua, one *Technomyrmex;* Tonga, Samoa, Borneo, India, one *Monomorium;* Samoa, Tonga, Ellice Islands, one *Pheidole;* India, Singapore, Celebes, China, Australia, Samoa, Tonga, Ellice Islands, Chile, one *Plagiolepis;* one Tahiti, Sandwich Islands, New Zealand, Chile, La Plata, Brazil, one *Solenopsis.*

Distribution of Lacertilia.

We shall now examine the distribution of some genera of Lizards; the data are from Boulenger.[39]

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[39] **Boulenger, G. A. Cat. Lizards Brit. Mus. (2nd edit.), vol. I, pp. 147–156, 162–168. London, 1885.**

Family *Geckonidæ*.

Gehyra Gray.

1. *Gehyra mutilata* Wiegm. Mascarene Islands: Mauritius and Rodriguez; Seychelles; Ceylon; Birma, Pegu; Malay Peninsula; Indian Archipelago; Philippines: Negros; Celebes; Timor Laut; New Guinea.—Western Mexico: San Blas and Presidio.

2. *Gehyra oceanica* Lesson. Moluccas; New Guinea; Admiralty Islands: Wild Island; Solomon Islands: Faro I.; Shortland Islands; Lord Howe's Island; Fiji Islands; Tonga Islands: Tongatabu; Samoa Islands; Savage Island; Rarotonga Island.

3. *Gehyra vorax* Girard. Loyalty Islands; New Hebrides: Erromango; Fiji Islands; Norfolk Island.

4. *Gehyra brevipalmata* Peters. Pelew Islands.

5. *Gehyra insulensis* Girard. Sandwich Islands.

6. *Gehyra baliola* A. Dum. New Guinea.

7. *Gehyra variegata* Dum & Bibr. Islands of Torres Str.; Murray Island; Sunday Island; Australia: Champion Bay, Houtman's Abrolhos, Peak Downs.

8. *Gehyra australis* Gray. Australia: Swan River, Port Essington, Port Darwin.

Perochirus Boulenger.

1. *Perochirus ateles* A. Dum. Philippines: Mindanaœ.

2. *Perochirus guentheri* Bouleng. New Hebrides: Erromango.

3. *Perochirus depressus* Fischer. Carolines: Ruk Island.

4. *Perochirus articulatus* Fischer. Carolines: Ponape.

5. *Perochirus scutellatus* Fischer. Greenwich Island, south of Carolines.

Lepidodactylus Fitzinger.

1. *Lepidodactylus aurantiacus* Beddome. Southern India.

2. *Lepidodactylus ceylonensis* Boulenger. Ceylon.

3. *Lepidodactylus lugubris* Dum. & Bibr. Malay Peninsula; Celebes; Amboyna; Murray Island; Pelew Islands; New Hebrides, Fiji, Society Islands: Tahiti; Island of Vati, South Pacific.

4. *Lepidodactylus labialis* Peters. Philippines: Mindanao.
5. *Lepidodactylus pulcher* Bouleng. Admiralty Islands.
6. *Lepidodactylus guppyi* Bouleng. Solomon Islands: Faro I.
7. *Lepidodactylus crepuscularis* Bavay. New Caledonia.
8. *Lepidodactylus cyclurus* Günther. New Caledonia.
9. *Lepidodactylus sauvagii* Bouleng. New Caledonia.

There can be little doubt that the Geckonidæ are a very old family of the Lacertilia, which go back at least to the lower Cretaceous, if not to the upper Jurassic. The distribution of the genera enumerated is very instructive.

Gehyra mutilata Wiegm. extends from the Mascarene Islands to the Seychelles, Ceylon, to the Malay Peninsula, Indian Archipelago, Philippines, Moluccas and New Guinea; it also occurs in western Mexico. This distribution again shows that there has been a land area reaching from the Mascaranes to New Guinea. The next species *Gehyra oceanica* Lesson reaches from the Moluccas eastward to the Cook Islands (Rarotonga), being found on the Admirality, Solomon, Fiji, Tonga and Samoa Islands, Savage Island and Lord Howe's Island. *Gehyra vorax* Girard extends this area to the New Hebrides, the Loyalty Islands and Norfolk Island; *Gehyra brevipalmata* to the Pelew group and *Gehyra insularis* to the Sandwich Islands. This distribution can only be explained by a former Indo-Pacific Continent extending from Malaysia to the west coast of America.

The distribution of the species of *Perochirus* Boulenger and *Lepidodactylus* Fitzinger give new proof for the former existence of this continent.

Family *Scincidæ.*

The family Scincidæ contains several genera, showing a very interesting geographical distribution.[39] These genera are Lipinia Gray, Emoa Gray and Ablepharus (*A. boutonii* Desjard).

Lipinia Gray.

1. *Lipinia semperi* Peters. Philippine Islands: Mindanao.
2. *Lipinia pulchella* Steindachu. Philippine Islands.

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[39] Boulenger, G. A. Catalogue of Lizards. Brit. Mus. (Sec. Ed.), vol. III, p. 253–256, p. 290–299, p. 346–348. London, 1887.

3. *Lipinia vulcanica* Girard. Philippine Islands: Caldera, Mindanao.

4. *Lipinia virens* Peters. Southeastern New Guinea.

5. *Lipinia anolis* Bouleng. Solomon Islands.

6. *Lipinia noctua* Lesson. New Guinea, Fiji, Tonga, Samoa, Society and Sandwich Islands.

Emoa Gray.

1. *Emoa cyanura* Lesson. Moluccas; Ternate, Mysol, Timor Laut; New Guinea: Admiralty, Solomon Islands, New Hebrides, Fiji, Savage I., Samoa, Rarotonga, Cook's Islands, Tahiti.

2. *Emoa mivarti* Bouleng. Admiralty Islands: Wild Island.

3. *Emoa cyanogaster* Lesson. Moluccas, New Guinea, Murray Island, Duke of York Island, Solomon Islands and New Hebrides.

4. *Emoa samoënsis* A. Dum. New Hebrides, Fiji, Tonga and Samoa Islands.

5. *Emoa callisticta* Peters & Doria. N. W. Guinea: Soron.

6. *Emoa atrocostata* Lesson. Philippines, Celebes, Moluccas, New Guinea, Santa Cruz and Caroline Islands.

7. *Emoa baudinii* Dum. & Bibr. Celebes, Moluccas, New Guinea.

8. *Emoa singaporensis* Steindachn. Singapore.

9. *Emoa nigra* Hombr. & Iacq. Caroline Islands, New Ireland, Solomon, Banks's, Fiji and Samoa Islands.

10. *Emoa adspersa* Steind. Fiji and Samoa Islands; Savage Island.

11. *Emoa parietalis* Peters. Borneo: Sarawak.

12. *Emoa jerdoniana* Stoliczka. Pinang.

13. *Emoa breviceps* Peters. Gaboon, Camaroons.

Ablepharus boutonii Desjard.

1. *boutonii* Desj. Mauritius, Zanzibar, Mozambique, Comoro Islands.

2. *A. boutonii pœcilopleurus* Wiegm. Peru: Pisacoma Islands; Puna Island, Gulf of Guayaquil; Sandwich Islands; Savage Island; Aldabra (Stejneger).[40]

3. *A. boutonii peronii* Cocteau. Java; Timor; Timor Laut; Amboina; Fly River, New Guinea; Murray Island; Islands of Torres Straits; W. Australia; Tasmania, Fiji Islands; Samoa, and Society Islands, New Hebrides, New Caledonia.

4. *A. boutonii rutilus* Peters. Fly River, New Guinea.

5. *A. boutonii metallicus* Boulenger. North Australia.

6. *A. boutonii quinquetæniatus* Günther. West coast of Africa.

7. *A. boutonii cognatus* Böttg. Nossi Bé, Madagascar.

8. *A. boutonii gloriosus* Stejneger. Glorioso Island.[40]

The genus Lipinia is found on the Philippines, New Guinea, Solomon Islands, Fiji, Tonga, Samoa, Society and Sandwich Islands; Emoa in Pinang; on the Moluccas New Guinea, Admiralty, Duke of York Island, New Ireland; Solomon Islands, New Hebrides, Fiji, Tonga, Samoa Islands. Tahiti, Savage Island; Rarotonga and Carolines and one species in W. Africa. *Ablepharus boutonii* Desjard. shows a most interesting distribution. West coast of Africa, Madagascar; Mauritius, Comoro Islands, Glorioso Island, Zanzibar, Mozambique; —Java, Timor, Moluccas, New Guinea, Islands of Torres Straits, North Australia, West Australia, Tasmania; New Caledonia; New Hebrides, Fiji, Samoa, and Society Islands, Savage Island, Sandwich Islands, Puna Island, Gulf of Guayaquil, Pisacoma Islands, Peru.

The distribution of these genera is only to be explained by the former existence of an Indo-Pacific Continent.

The Distribution of the Hydrophidæ.

This family is found in the Pacific; but in the Indian Ocean it only reaches west to the Persian Gulf.[41] It is totally absent from the Atlantic, and the whole African portion of the Indian Ocean. The Hydrophidæ extend north to Japan, south to Tasmania and New Zealand; east to the west-coast of America from Mexico to Ecuador. Only one species is found on this coast *Hydrus platurus* Linn.; recorded from Salina Cruz, Mexico; Panama; and off the coast of Ecuador.

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[40] Stejneger, Leonhard. On some collections of Reptiles ana Batrachians from East Africa and the adjacent islands, recently received from Dr. W. L. Abbott and Mr. William Astor Chandler, with descriptions of new species. Proc. U. S. Nat. Mus., vol. XVI, p. 711–741. [No. 970]. Washington, 1893.

[41] Boulenger, G. A. Catalogue of Snakes. Brit. Mus., vol. III, p. 264–309, 1896.

This family is certainly younger than Miocene, since no members of it, are found in the Westindian Sea. It probably became much differentiated after the formation of the Indopacific Ocean.

The geographical distribution of different genera of Birds on the Pacific Islands.

Let us consider the distribution of different genera of the COLUMBIÆ. Our knowledge of the fossil Columbæ commences with the lower miocene of Allier in France, *Columba calcaria* Miln. Edw. The very peculiar group, represented by the Dididæ (Didus and Pezophaps) from the Mascarene Islands, Mauritius and Bourbon, were exterminated long ago. Living specimens of (*Didus ineptus*) were seen as late as in 1679; of *Pezophaps solitarius* (the Solitaire) in 1761.

The Columbidæ are certainly geologically an old group.

Family TRERONIDÆ.

Subfamily *Ptilinopodinæ.*

Distribution of the genus Ptilinopus Swainson, 1825 (from Salvadori).[42]

1. *Ptilinopus flavicollis* Finsch & Hartl. Timor and Flores.
2. *Ptilinopus xanthogaster* Wagl. Banda, Khoor, Ké, Tenimber Islands, Damma Island, and Lettie.
3. *Ptilinopus ewingi* Gould. Northern Australia from Port Essington to Cape York.
4. *Ptilinopus swainsoni* Gould. Eastern Australia from Cape York to New South Wales, the Islands in Torres Strait and S. E. New Guinea.

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[42] Salvadori T. Catalogue of the Columbæ or Pigens in the collection of the British Museum, p. 83–112. London, 1893. Catalogue of the Birds in the British Museum, vol. XXI. London, 1893.

5. *Ptilinopus richardsi* Rams. Solomon Islands: Ugi.

6. *Ptilinopus greyi* G. R. Gray. New Caledonia, with Island of Pines; Loyalty Islands: Livu; New Hebrides: Erromango, Aniva, Vatè, Mallicolo; Santa Cruz Islands: Vanicoro.

7. *Ptilinopus perousei* Peale. Fiji, Tonga and Samoa Islands.

8. *Ptilinopus porphyraceus* Temm. Fiji, Tonga Islands and Savage Island.

9. *Ptilinopus fasciatus* Peale. All the Samoan Islands.

10. *Ptilinopus rarotongensis* Hartl. & Finsch. Rarotonga.

11. *Ptilinopus purpuratus* Gmel. Society Islands: Tahiti.

12. *Ptilinopus chrysogaster* G. R. Gray. Society Islands: Huaheine and Raiatea.

13. *Ptilinopus huttoni* Finsch. Austral Group: Island of Rapa.

14. *Ptilinopus coralensis* Peale. Paumotu Group: Island of Carlsoff.

15. *Ptilinopus smithsonianus* Cass. Paumotu Group (some Island).

16. *Ptilinopus dupetit-thouarsi* Néboux. Marquesas: Christina, Nukahiwa.

17. *Ptilinopus mercieri* Des Murs & Prév. Marquesas Islands: Nukahiwa.

18. *Ptilinopus tristrami* Salvad. Marguesas: Hivaoa.

19. *Ptilinopus pelewensis* Hartl. & Finsch. Pelew Islands.

20. *Ptilinopus ponapensis* Finsch. Eastern Carolines: Ruck group.

21. *Ptilinopus hernsheimi* Finsch. Eastern Carolines: Kushai.

22. *Ptilinopus roseicapillus* Less. Ladrone or Marianne Islands.

Chrysœnas Bonaparte, 1854.

This genus is confined to the Fiji Islands. There are three species, each confined to special islands of the group.[42]

1. *Chrysœnas luteovirens* Hombr. & Jacg. Fiji Islands: Balau, Ovalau, Viti Levu.

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[42] Salvadori, l. c., p. 155–158.

2. *Chrysœnas victor* Gould. Fiji Islands: Bua, Vanua Levu, Taviuni, Nyami, Lanthala.

3. *Chrysœnas viridis* Layard. Fiji Islands: Kandavu.

Drepanoptila Bonaparte, 1855.

This genus with the single species *Drepanoptila holosericia* Temm. & Knip. is confined to New Caledonia, with the Isle of Pines.[42]

The geographical distribution of these genera is very interesting.

Ptilopinus. The Moluccas have two peculiar species confined to different islands; *Northern Australia* has one, and Eastern Australia with the Island of Torres Strait another peculiar species. Seventeen species are found on the following islands: Solomon I., New Caledonia, Loyalty I., New Hebrides, Santa Cruz Islands, Fiji, Tonga, Samoa, Savage Island; Raratonga, Society Islands; Austral group: Island of Rapa; Paumotu group: Island of Carlsoff; some Island of Paumotu group; Marquesas; Pelew; Eastern Carolines: Ruck group: Kushai; Ladrone Islands. Of these 17 species, 15 are confined to special islands. This fact and the differentiation of the genus *Chrysoenas* restricted to Fiji Islands, into three peculiar species confined to special islands, and *Drepanoptila* with a single species on New Caledonia shows that these many islands were not stocked by immigrants, but that they were formerly connected to form a continent.

The genus *Alectroenas* G. R. Gray, 1840, which belongs to the subfamily Ptilinopodinæ is confined to the Madagascarian region.[42] There are four species:

1. *Alectroenas madagascariensis* Linn. Madagascar with Nossibe Isl.
2. *Alectroenas nitidissima* Scop. Mauritius.
3. *Alectroenas sganzini* Des Murs. Comoro Islands.
4. *Alectroenas pulcherrima* Scop. Seychelles Islands.

This again shows the close relationship between the Madagascarin and the Indo-Pacific region, which, as we have seen before, can only be explained by former land connection.

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[42] Salvadori, l. c., p. 158–160.

[42] Salvadori, l. c., p. 160--165.

Subfamily *Carpophaginæ*.[42]

Serresius Bonaparte, 1855.

This genus is restricted with a single species, *S. galeatus* Bonap., to the Marquesus Islands.

Globicera Bonaparte, 1854.

1. *Globicera pacifica* Gmel. From the Samoa Islands on the east to New Guinea; Port Moresby, New Guinea; New Hebrides; Louisiade Archipelago; Fiji Islands; Tonga Islands; Samoa Islands.
2. *Globicera myristicivora* Scop. Western New Guinea and the surrounding western Papuan Islands; Waigiou, Mysol.
3. *Globicera rubricera* G. R. Gray. New Ireland; New Britain; New Hanover and Duke of York Island.
4. *Globicera rufigula* Salvad. Solomon Islands.
5. *Globicera oceanica* Less. Carolines and Pelew Islands.
6. *Globicera auroræ* Peale. Aurora or Maitea Island, Society group.
7. *Globicera wilkesi* Peale. Tahiti, Society group.

The species of these two genera are found from the Papuan Islands and New Guinea to the Marquesas Islands.

Family COLUMBIDÆ.[42]

Subfamily *Columbinæ*.

Janthoenas Reichenbach, 1852.

1. *Janthoenas palumboides* Hume. Andamanes and Nicobars.
2. *Janthoenas janthina* Temm. Japan and Loo Choo Islands.
3. *Janthoenas jouyi* Stejneg. Loo Choo Islands.
4. *Janthoenas versicolor* Stejneg. Bonin Islands.
5. *Janthoenas nitens* Stejneg. Bonin Islands; Parry group: Bailey Islands and Sulphur Islands.
6. *Janthoenas griseogularis* Wald. & Layard. Philippine Islands, from Luzon to Mindanao; and also Sulu Islands and N. Borneo.

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[42] Salvadori, l. c., p. 171--181.

[42] Salvadori, l. c., p. 308--319.

7. *Janthoenas metallica* Temm. Timor.

8. *Janthoenas albigularis* Bonap. From the Halmahera and Amboyna groups through the Papuan Islands to the Louisiades.

9. *Janthoenas pallidiceps* Rams. Duke of York Island.

10. *Janthoenas philippana* Rams. Solomon Islands; Ugi.

11. *Janthoenas hypoenochroa* Gould. New Caledonia; Isle of Pines; Loyalty Islands.

12. *Janthoenas leopoldi* Tristr. New Hebrides.

13. *Janthoenas vitiensis* Quoy & Gaim. Fiji Islands.

14. *Janthoenas castaneiceps* Peale. Samoa Islands.

This genus shows a very extensive distribution; Andamans and Nicobars, N. Borneo, Sulu Islands, Philippines, Loo Choo Islands, Japan, Bonin Islands, Timor, Halmahera group, Amboina group, Papuan Islands, Louisiade Archipelago, Duke of York Islands, Solomon, New Hebrides, Loyalty Islands, New Caledonia, Fiji Islands, Samoa Islands.

This distribution is easily explained by the former land connection of the different islands.

Family PERISTERIDÆ.

Subfamily *Geotrigonidæ.*[42]

Genus *Phlegoenas* Reichenbach, 1851.

1. *Phlegoenas luzonica* Scop. Luzon, Philippines.

2. *Phlegoenas crinigera* Reichenb. Mindanoa, Basilan, Philippines.

3. *Phlegoenas platenæ* Hartert. Mindoro, Philippines.

4. *Phlegoenas tristigmata* Temm. N. Celebes, Menado.

5. *Phlegoenas bimaculata* Salvad. S. Celebes, Makassar.

6. *Phlegoenas rufigula* Pucher. & Jacq. New Guinea, with the N. W. Papuan Islands: Waigiou, Salawatti, Mysol and Jobi.

7. *Phlegoenas helviventris* Rosenb. Aru Islands and southern New Guinea.

8. *Phlegoenas beccarii* Salvad. N. W. New Guinea.

9. *Phlegoenas margaritæ* D'Alb. & Salvad. New Guinea, Jobi, Duke of York Island, New Britain.

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[42] **Salvadori, l. c., p. 583–604.**

10. *Phlegoenas johannæ* Sclat. Duke of York Island.

11. *Phlegoenas granti* Salvad. Guadalcanar, Solomon Islands.

12. *Phlegoenas vitiensis* Finsch. Fiji Islands.

13. *Phlegoenas stairi* G. R. Gray. Tonga Islands.

14. *Phlegoenas samoensis* Finsch & Hartl. Samoa Islands.

15. *Phlegoenas canifrons* Hartl & Finsch. Pelew Islands.

16. *Phlegoenas virgo* Reichenow. Pelew Islands.

17. *Phlegoenas pampusan* Quoy et Gaim. Marianne or Ladrone Islands.

18. *Phlegoenas kubaryi* Finsch. Ruk I., Carolines.

19. *Phlegoenas erythroptera* Gmel. Eimeo, Society Islands.

20. *Phlegoenas albicollis* Salvad. Bow Island, Paumotu Islands.

21. *Phlegoenas pectoralis* Peale. Carlsoff, Paumotu Islands.

22. *Phlegoenas yapensis* Hartl. & Finsch. Uap, Mackenzie Islands.

The genus *Phlegoenas* shows a very extensive differentiation of species on the different groups of islands. On the Philippines there are three species, two confined to single islands, and the third to two other islands. Celebes has a peculiar species on the north and one on the south end. One species is found on the N. W. Papuan Islands and New Guinea, another one on the Aru Islands and southern New Guinea, a third one is on New Guinea, Duke of York Island and New Britain. All the other 14 species are restricted to single localities: New Guinea; Duke of York Island; Guadalcanar, Solomon Islands; Fiji Islands; Tonga Islands; Samoa Islands; two to the Pelew Islands; Marianne Islands; Ruk Island, Carolines; Eimeo, Society Islands; Bow Island, Paumotu group; Carlshoff, Paumotu group; Uap, Mackenzie Islands.

This peculiar differentiation of Phlegoenas can only be explained by the former connection of these islands, and not by accidental immigrants. This is another proof for the former existence of a Pacific Continent.

I shall now discuss the geographical distribution of two genera of the Sturnoid Passerine Birds, the Sturniformes.

Section STURNIFORMES.

Family *Sturnidæ.*

Subfamily *Sturninæ.*[43]

Genus *Aplonis* Gould, 1836.

1. *Aplonis cantor* Müll. Mysol, Salawatti, Batanta, New Guinea, Louisiade Islands, Admirality groups of islands, New Britain, Duke of York Island, Solomon Islands.

2. *Aplonis feadensis* Ramsay. Fead Island.

3. *Aplonis crassa* Scl. Tenimber Islands, Larat, Timor Laut.

4. *Aplonis rufipennis* Layard. New Hebrides.

5. *Aplonis atronitens* Gray. Loyalty Islands.

6. *Aplonis striata* Gmel. New Caledonia, Isle of Pines.

7. *Aplonis fuscus* Gould. Norfolk Island and Lord Howe's Island.

8. *Aplonis vitiensis* Layard. Fiji Islands, Rotumah Island, (north of Fiji Islands).

9. *Aplonis tabuensis* Gmel. Tonga Islands.

10. *Aplonis fortunæ* Layard. Fortuna Island (between Fiji and Samoa Islands).

11. *Aplonis brunnescens* Sharpe. Savage Island.

12. *Aplonis atrifusca* Peale. Samoa Islands.

13. *Aplonis brevirostris* Peale. Samoa Islands.

14. *Aplonis cinerascens* Hartl. & Finsch. Rarotonga, Cook Islands.

15. *Aplonis inornata* Sharpe. Raiatea, Society Islands.

16. *Aplonis kittlitzi* Finsch. & Hartl. Carolines, Ponapé, Kuschai, Ruk and Lugunor.

17. *Aplonis pelzelni* Finsch. Interior mountains of Ponapé.

Family PLOCEIDÆ.

Subfamily *Viduinæ.*

Genus *Erythrura* Swainson, 1837.

1. *Erythrura prasina* Sparrm. From Southern Tenasserim, down the Malayan Peninsula to Sumatra, Java and Borneo.

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[43] Sharpe, R. Bowdler. Catalogue of the Passeriformes, or Perching Birds in the collection of the Brit. Mus. Sturniformes. London, 1890, p. 125--137, p. 380--387. Catalogue of the Birds in the Brit. Mus., Vol. XIII. London, 1890.

2. *Erythrura forbesi* Sharpe. Tenimber Islands.
3. *Erythrura tricolor* Vieill. Timor.
4. *Erythrura trichroa* Kittl. Ternate, New Guinea, Carolines, Solomon Islands.
5. *Erythrura psittacea* Gmel. New Caledonia.
6. *Erythrura cyaneifrons* E. L. Layard. Lifu, Loyalty Islands, Tanna, New Hebrides.
7. *Erythrura serena* Scl. Island of Aneitum, New Hebrides.
8. *Erythrura regia* Scl. Island of Api, New Hebrides.
9. *Erythrura pealii* Hartl. Reva, Taviuni, Fiji Islands.
10. *Erythrura kleinschmidti* Finsch. Viti Levu, Fiji Islands.
11. *Erythrura cyanovirens* Peale. Samoa Islands.

Of the seventeen species of Aplonis only one, *A. cantor* Müll., has a more extensive distribution. It extends from Mysol, Salavati, Batanta, small islands at the west end of New Guinea, through New Guinea and the Louisiade Islands, and from the Admiralty Islands, New Britain and Duke of York Island to the Solomon Islands. *A. fuscus* Gould, occurs on Norfolk and Lord Howe's Island. The other fifteen species are restricted to special localities: Tenimber Islands; Fead Island; New Hebrides; Loyalty Islands; New Caledonia, with Isle of Pines; Fiji Islands and Rotumah Island; Tonga Islands; Fortuna Island; Savage Island; two Samoan Islands; Rarotonga Island; Raiatea, Society Islands; Carolines: Ponapé, Kuschai, Ruk and Lugunor; Interior mountains of Ponapé.

The genus Erythrura Swainson, also shows a very interesting distribution; *E. prasina* Sparrm., is found from southern Tenasserim, down the Malayan Peninsula to Sumatra, Java and Borneo; *E. trichroa* Kittl., on the Moluccas, New Guinea, Carolines and Solomon Islands; *E. cyaneifrons* E. L. Layard, on the Loyalty Islands and the New Hebrides. The remaining eight species have special localities: Tenimber Islands; Timor; New Caledonia; Island of Aneitum, New Hebrides; Island of Api, New Hebrides; Rewa, Taviuni, Fiji Islands; Viti Levu, Fiji Islands; Samoa Islands.

The peculiar differentiation of Aplonis and Erythrura on the different groups of islands can only be explained by their continental origin.

The distribution of the genus Myzomela of the Honey-eaters or Honey-suckers may next be considered.

Group CINNYRIMORPHÆ.[44]

Family *Meliphagidæ.*

Subfamily *Myzomelinæ.*

Genus *Myzomela* Vigors and Horsfield, 1826.

1. *Myzomela chloroptera* Walden. Celebes.
2. *Myzomela wakoloensis* H. O. Forbes. Island of Bourou.
3. *Myzomela simplex* Gray. Halmahera Group.
4. *Myzomela rubrobrunnea* Meyer. Misori Island in the Bay of Geelwink.
5. *Myzomela rubrotincta* Salvad. Obi Island.
6. *Myzomela boiei* S. Müller. Banda Islands.
7. *Myzomela vulnerata* S. Müller. Timor.
8. *Myzomela annabellæ* Sclater. Tenimber Group: Loetoer Island.
9. *Myzomela adolphinæ* Salvad. New Guinea, Arfac Mountains.
10. *Myzomela rosenberyi* Schleg. New Guinea: Astrolabe Mountains.
11. *Myzomela eques* Less. New Guinea, Dorey and Mysol Island.
12. *Myzomela nigrita* Gray. Western and Southern New Guinea and Aru Islands.
13. *Myzomela erythrocephala* Gould. Northern Australia to Aru Islands and New Guinea.
14. *Myzomela forbesi* Ramsay. Woodlark Islands, north of Louisiade Islands.
15. *Myzomela guentheri* Gadow. New Britain.
16. *Myzomela cineracea* Scl. New Britain.
17. *Myzomela cruentata* Meyer. New Guinea, New Ireland, New Britain.

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[44] Gadow, Hans. Catalogue of the *Passeriformes*, or Perching Birds, in the collection of the British Museum. *Cinnyrimorphæ* containing the Families Nectarinidæ and Meliphagidæ (Sun-Birds and Honey-Eaters). London, 1884, p. 128--144. Catalogue of the *Birds* in the British Museum, Vol. IX, London, 1884.

18. *Myzomela sclateri* Forbes. Palakuru Island, off New Britain.

19. *Myzomela sanguinolenta* Creeper. Australia.

20. *Myzomela nigra* Gould. Greater part of Australia.

21. *Myzomela pectoralis* Gould. North Australia.

22. *Myzomela obscura* Gould. North Australia and opposite parts of New Guinea.

23. *Myzomela pulcherrima* Ramsay. Solomon Islands, Ugi.

24. *Myzomela cardinalis* Gmel. New Hebrides.

25. *Myzomela caledonica* Forbes. New Hebrides to New Caledonia.

26. *Myzomela jugularis* Peale. Fiji Islands.

27. *Myzomela nigriventris* Peale. Samoa Islands.

28. *Myzomela rubrata* Less. Caroline Islands.

29. *Myzomela chermesina* Gray. Caroline Islands, Ponapé Island, New Hebrides, Rotumah (north of Fiji).

Myzomela has a very extensive distribution, reaching from Celebes over the Moluccas, Papuan Islands, New Guinea to Australia. From New Britain and New Ireland (Bismarck Archipelago) to the Solomon Islands, New Hebrides, New Caledonia, Fiji, Samoa Islands, Rotumah, Carolines.

Of the 29 species, 21 are restricted to special localities. Here we have again the peculiar differentiation, which can only be explained by former land connection.

Subfamily *Zosteropinæ*.

Genus Zosterops Vigors & Horsfield,[44] 1827.

The genus Zosterops has the most remarkable geographical distribution. *Range:* All over Africa south of the Sahara; Island of St. Thomas and Prince's Island in the Bight of Benin, W. Africa; Socotra; Madagascar; the Mascarene Islands; Comoro; Glorioso; Seychelles Islands; entire Indian peninsula and Ceylon; Burmese countries; the whole of China, extending into Amoor Land; Japan; Formosa; Hainan; Malay peninsula; all the Indo-Malayan islands; Moluccas; New Guinea and adjacent Papuan Islands; throughout the islands of the Pacific Ocean (with a few exceptions); New Caledonia; Lord Howe's Island; Norfolk Island; Australia with Tasmania, New Zealand, Chatham Islands.

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[44] **Gadow, l. c., p. 146–203.**

Gadow enumerated in 1884 eighty-five species of Zosterops. The number of species known to-day must certainly be much greater. The differentiation into species is very remarkable, and a great many are restricted to single islands. I mention the following species.

1. *Zosterops cærulescens* Lath. Australia; New Zealand; Chatham Island.

2 and 3. *Zosterops albigularis* Gould and *Z. tenuirostris* Gould. Norfolk Island.

4. *Zosterops strenua* Gould. Lord Howe's Island.

5. *Zosterops tephropleura* Gould. Lord Howe's Island.

6. *Zosterops griseonata* Gray. New Caledonia and Erromango, New Hebrides.

7. *Zosterops vatensis* Tristr. Vate, New Hebrides.

8. *Zosterops flavifrons* Lath. Aneitum, Erromango, New Hebrides.

9. *Zosterops inornata* E. L. & C. L. Layard. Lifu, Loyalty Islands.

10. *Zosterops minuta* E. L. & C. L. Layard. Lifu, Loyalty Islands.

11. *Zosterops melanops* Gray. Loyalty Islands.

12. *Zosterops flaviceps* Peale. Levuka, Ovalau, Taviuni, Fiji Islands.

13. *Zosterops explorator* Layard. Kandavu, Levuka, Ovalau, Fiji Islands.

14. *Zosterops hypolais* Hartl. & Finsch. Island of Uap, Mackenzie Group.

15. *Zosterops oleagina* Hartl. & Finsch. Island of Uap, Mackenzie Group.

16. *Zosterops cinerea* Kittl. Kushai Island, E. Carolines.

17. *Zosterops ponapensis* Finsch. Island of Ponapé, Carolines.

18. *Zosterops semperi* Hartl. & Finsch. Eastern and Central Carolines; Pelew Islands.

19. *Zosterops finschii* Hartl. Pelew Islands.

20. *Zosterops conspicillata* Kittl. Island of Guam, Ladrones.

21. *Zosterops rendovæ* Tristram. Island of Rendova, Solomon Islands.

22. *Zosterops hypoxantha* Salvad. New Britain.

23. *Zosterops griseotincta* Gray. Louisiade Islands.

24. *Zosierops xanthochroa* Gray. New Caledonia and the Isle of Pines.

25. *Zosterops grayi* Wall. Ké Islands, Moluccas.

26. *Zosterops aureigula* Salv. Island of Jobi, Bay of Geelwink, N. W. New Guinea.

27. *Zosterops chloris* Bonap. Banda Island, Moluccas.

28. *Zosterops buruensis* Salvad. Island of Bouru, Moluccas.

29. *Zosterops uropygialis* Salvad. Little Ké Island, Moluccas.

30. *Zosterops atriceps* Gray. Island of Batchian, Moluccas.

31. *Zosterops fuscifrons* Salvad. Halmahera, Moluccas.

32. *Zosterops mysoriensis* Meyer. Misori Bay of Geelwink, N. W. New Guinea.

33. *Zosterops longirostris* Ramsay. Heath Island, southeastern end New Guinea.

34. *Zosterops griseiventer* Sclater. Tenimber Islands.

35. *Zosterops citrinella* Bonap. Timor.

36. *Zosterops muelleri* Hartl. Timor.

37. *Zosterops aureifrons* Wallace. Flores and Sumbawa.

38. *Zosterops gallio* Salv. Java.

39. *Zosterops javanica* Horsf. Java.

40. *Zosterops fallax* Gadow. Java and Sumatra.

41. *Zosterops frigida* Hartl. Sumatra.

42. *Zosterops atricapilla* Salv. Mount Singalan, Sumatra.

43. *Zosterops chlorates* Hartl. Mount Dempo, Sumatra, 8000 feet.

44. *Zosterops flava* Horsf. Java, Sumatra and Borneo. Bornean specimens lighter.

45. *Zosterops atrifrons* Wallace. Celebes.

46. *Zosterops everetti* Tweed. Philippine Islands: Dinagat.

47. *Zosterops meyeni* Bonap. Philippine Islands: Luzon.

48. *Zosterops japonica* Temm. & Schleg. Japan.

49. *Zosterops ceylonensis* Holdsw. Hills of Ceylon.

50. *Zosterops palpebrosa* Temm.[45] All over India from the Himalayas to Ceylon with the Laccadives; Burmese countries eastwards into South China; Andamans and Nicobars.

51. *Zosterops abyssinica* Guérin. Socotra Island, also Abyssinia, 3000–10,000 feet high.

52. *Zosterops anjuanensis* E. Newton. Comoro group: Anjuan and Grand Comoro Islands.

53. *Zosterops madagascariensis* Gmel. Madagascar and Glorioso Islands.

54. *Zosterops kirki* Shelley. Grand Comoro Island.

55. *Zosterops modesta* E. Newton. Seychelles.

56. *Zosterops semiflava* E. Newton. Seychelles: Marianne Island.

57. *Zosterops mayottensis* Schleg. Island of Mayotte.

58. *Zosterops mauritiana* Gmel. Mauritius.

59. *Zosterops borbonica* Gmel. Bourbon or Island of Réunion.

60. *Zosterops olivacea* Linn. Bourbon or Réunion'

61. *Zosterops chloronota* Gray. Mauritius.

62. *Zosterops lugubris* Hartl. Island of S. Thomas in the Bay of Biafra, W. Africa.

63. *Zosterops leucophæa* Hartl. Isla do Principé in the Bay of Biafra, W. Africa.

64. *Zosterops ficedulina* Hartl. Isla do Principé in the Bay of Biafra, W. Africa.

Of the 85 species of Zosterops mentioned by Gadow, 61 are restricted to special localities, and of these 58 to special islands or island groups. This genus traverses Africa from the west (islands in the Bay of Biafra) to the east (Abyssinia and Socotra). It is found on all the islands on the southeast coast of Africa, Madagascar, Comoro Islands, Grand Comoro, Island of Mayotte, Glorioso Islands, the Mascarenian Islands, Bourbon and Mauritius, Aldabra and the Seychelles. The next localities eastwards are the Laccadives, Ceylon, the whole of India with the Himalayas; then follow the Burmese countries to southern China and north to southern Amoor Land; it occurs also on the Andaman and Nicobar Islands. Japan has a peculiar species, but the greatest differentiation is found on the Sunda Islands, Celebes and especially the Moluccas, and the numerous small islands and groups of islands known as the Papuan Islands. From New Guinea Zosterops ranges over to Australia, Tasmania, New Zealand and the Chatham Islands. Peculiar species are found on Lord Howe's (2) and Norfolk Islands (2); New Caledonia, the Loyalty Islands (3); New Hebrides (2); Fiji Islands (3); Carolines (3); Mackenzie Group (2); Pelew Islands; Ladrones; Solomon Islands: Rendove; Louisiade Islands; New Britain.

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[45] Gadow believes that all the specimens from these localities belong to *Z. palpebrosa* Temm. It would be strange if this species is different from the others, which have often very restricted localities.

The extensive distribution of Zosterops and the very great differentiation into many species on islands which are often close together, or separated by very great distances from each other, can only be explained by postulating the existence of a former continent.

(*To be continued.*)

EDITOR'S TABLE.

THE meeting of the British Association, held in Toronto in August, was a success in every respect. The attendance (some 1300) was large, the addresses were good and many of the papers read were important, while the city of Toronto outdid itself in entertaining its guests. The way in which the spirit of the Victorian Jubilee was manifested was noticeable, and the guests could not but realize that they were attending the meeting of a British Association. We do not mean to infer by this that the guests were made uncomfortable, but that the national feeling could not help showing itself, in spite of such utterances as those of Sir John Evans in his Presidential Address, when he said:

"Our gathering this year presents a feature of entire novelty and extreme interest, inasmuch as the sister association of the United States of America—still mourning the loss of her illustrious President, Professor Cope—and some other learned societies have made special arrangements to allow of their members coming here to join us. I need hardly say how welcome their presence is, nor how gladly we look forward to their taking part in our discussions and aiding us in an interchange of thought. To such a meeting the term 'international' seems almost misapplied. It may rather be described as a family gathering, in which our relatives, more or less distant in blood, but still intimately connected with us in language, literature and habit of thought, have spontaneously arranged to take part."

Our space will not allow us to print a list of the papers presented nor to reproduce in full the various valuable addresses given. Any summary or abstract would do injustice to some of the most scholarly summaries of progress which we have ever known. As these are presented in full in both *Science* and *Nature*, the limitations of our pages are the less to be regretted. We may, however, indulge in a few notes upon matters suggested by the meetings and by the addresses given.

Naturally the contrasting features of the two associations come first to mind. In some respects our association seems the better, in others we have something to learn from our transatlantic cousins; while in still other features the two organizations are essentially identical. Thus both are subdivided into sections (the sections, however, not having the same limits in the two). These sections listen to papers and to Presidential Addresses, and the association, as a whole, is offered numerous entertainments, junkets, and the like, by its hosts.

It is not necessary to detail the points in which we think our own association is the better, but we may be pardoned if we point out some features in which we think the British Association superior to our own.

In the first place the Presidental Addresses delivered before the British Association strike us as, on the whole, better than those with which our audiences are greeted. While now and then an American address will rise to as high a standard as anything that Great Britain can boast, theirs are on the average the more thoughtful and scholarly, while ours too often have a prefunctory air and lack in breath of view.

In personnel of those who attend, the British Association again has the advantage. In England it is the fashion to attend these annual meetings, and no one there has reached such a pinnacle of greatness that he can afford to ignore or neglect this national society. As a result, at their gatherings one can be reasonably certain of meeting most of those who are the leaders in English scientific thought. In America, on the other hand. the tendency is in the other direction. It would be an easy matter to give a considerable list of names of those prominent in American science, whose faces are never seen at the association meetings.

In England many of the local scientific societies are affiliated with the British Association and send their delegates regularly to the meetings. This year, as in years past, there was a conference of these delegates, and Professor Miall, of Leeds, made some remarks before them, which seem to us so suggestive and so valuable that we must make them the text for a short digression from our main subject.

One who is at all familiar with the material which is constantly submitted for publication in our scientific journals soon realizes that there is an immense amount of wasted, or misdirected energy among the scientifically inclined. Naturally these persons attack the most prominent questions—questions far beyond their capacities, or at least beyond their facilities for doing good work. As we once heard it expressed, only the editor of a scientific periodical can realize how many second class men write upon first class problems. Now there is work, good and valuable work, which these willing individuals can do. In most cases they are removed from library facilities and large collections; not unfrequently they are ignorant of all languages except their mother tongue. They are good observers, have good reasoning powers, but are the victims of their environment. It was to such provincial naturalists that Professor Miall spoke, and he advised them to turn their attention to the study of the life-histories of the common forms about them, and to his every word we say a hearty "amen." We know too little about our intimate neighbors; we are too apt to think that some form from the interior of Africa or from some remote island of the South Seas is far more interesting, far more important, than those objects which we see every day. Yet these forms often possess extreme interest. We have only to think how glad our European fellow workers are to get our ganoids and our Limulus, to realize that we have important animals and plants in our own country. This study of the life-histories needs no library, no collections, no acquaintance with foreign tongues. It needs only a pair of sharp eyes to turn out work which shall be as full of interest and as valuable as the classic paper of Smeathman upon the white ants. That our most familiar forms will reveal new and unsuspected points of interest, is evidenced by Dr. H. H. Wilder's recent discovery that, contrary to all our text books, several of our salamanders are lungless. One cannot read the pages of the late W. H. Gibson, without realizing that there is much to be found out about the animals and plants about our very doors; and every new fact about the commonest form is a positive contribution to knowledge.

But *revenons á nos moutons.* Is it not possible for some of our smaller local societies to become affiliated with the American Association in such a way as to be productive of mutual assistance? Cannot the association act as a medium of intercourse and of exchange of ideas? Cannot the members of these societies have conferences similar to those which take place in England? We are aware that what have been termed "affiliated societies" meet with the American Association, but these societies are not the ones to which we refer. We are also aware that the Society of Naturalists started out with a somewhat similar idea. It was dropped by that organization, not because there was no need of it, but for other reasons.

Again, the British Association annually appropriates large sums (this year $7,750) in aid of various scientific investigations. Our association has recently entered upon a similar course, but so far its appropriations have been small. To the statement that it appropriates all that it can, there is a ready reply. Look at the annual report of the expenditures of the association and you will find chances for economy. Read through one volume of the "Proceedings" and you will conclude that that portly annual volume could be reduced in size without the slightest loss to science. The money saved by this could be very advantageously used in other ways, and it would not be insignificant in amount.

Where all the addresses were so good it seems somewhat invidious to select one as especially noteworthy, but the review of thirteen years progress in physiology by Professor Michael Foster, seems to the non-physiological writer as, perhaps, the most striking and suggestive. We call it up however, not for the purpose of making any comparisons, but for the purpose of quoting from it one portion which seems especially timely after the recent attempts to get Congress and the Legislatures of Massachusetts and other States to pass anti-vivisection laws. When one knows the misstatements and perversions—to use no harsher term —of the advocates of these bills, it is a pleasure to be able to quote a direct reply to one of their deliberate misrepresentations. In his concluding remarks Professor Foster said:

"And I will be here so bold as to dare to point out that this development of his science must, in the times to come, influence the attitude of the physiologist towards the world, and ought to influence the attitude of the world towards him. I imagine that if a plebiscite, limited even to instructed, I might almost say scientific men, were taken at the present moment, it would be found that the most prevalent conception of physiology is that it is a something which is in some way an appendage to the art of medicine. That physiology is, and always must be, the basis of the science of healing is so much a truism that I would not venture to repeat it here were it not that some of those enemies, alike to science and humanity, who are at times called anti-vivisectionists, and whose zeal often outruns, not only discretion, but even truth, have quite recently asserted that I think otherwise. Should such a hallucination ever threaten to possess me, I should only have to turn to the little we yet know of the physiology of the nervous system and remind myself how great a help the results of pure physiological curiosity—I repeat the words, pure physiological curiosity, for curiosity is the mother of science—have been, alike to the surgeon and the physician, in the treatment of those in some way most afflicting maladies, the diseases of the nervous system. Now physiology is, and always must be, the basis of the science of healing; but it is something more. When physiology is dealing with those parts of the body which we call muscular, vascular, glandular tissues and the like, rightly handled she points out the way not only to amend that which is hurt, to repair the damages of bad usage and disease, but so to train the growing tissues and to guide the grown ones as that the best may be made of them for the purposes of life. She not only heals, she governs and educates. Nor does she do otherwise when she comes to deal with the nervous tissues. Nay it is the very prerogative of these nervous tissues that their life is above that of all the other tissues, contingent on the environment and susceptible of education. If increasing knowledge gives us increasing power so to mould a muscular fibre that it shall play to the best the part which it has to play in life, the little knowledge we at present possess gives us at least as much confidence in a coming far greater power over the nerve cell. This is not the place to plunge into the deep waters of the relation which the body bears to the mind, but this at least stares us in the face, that changes in what we call the body bring about changes in what we call the mind. When we alter the one, we alter the other. If, as the whole past history of our science leads us to expect, in the coming years a clearer and clearer insight into the nature and conditions of that molecular dance which is to us the material token of nervous action, and a fuller, exacter knowledge of the laws which govern the sweep of nervous impulses along fibre and cell, give us wider and directer command over the moulding of the growing nervous mechanism and the maintenance and regulation of the grown one, then assuredly physiology will takes it place as a judge of appeal in questions not only of the body, but of the mind; it will raise its voice not in the hospital and consulting-room only, but also in the Senate and the school."

We have received notice of the recent formation at New Orleans of "The Louisiana Society of Naturalists" with Prof. J. H. Dillard, of Tulane University, as President, and Mr. E. Foster, Secretary. The Society has already about 45 members, nearly all of whom are workers in some branch of natural science. It proposes to work up the fauna and flora of the State in a systematic manner, a task never before attempted. One has only to look at the map of Louisiana—possessing the mouth of one of the largest rivers in the world, numerous bayous, vast salt and freshwater lakes, large islands and bars, extensive swamps and forests—to see what grand possibilities are in store for this society if its members will study geographical distribution in the broad and yet detailed way in which it is done by the Biological Survey of the Department of Agriculture. We hope to receive reports from time to time of the results achieved by the society.

General Notes.

BOTANY.

Pfaff's Observations on the Nature of Ivy Poisoning.—Considering the frequency of Rhus poisoning and the abundance of our two noxious species, it is remarkable that the exact nature of the irritant has so long eluded discovery. The most widely divergent views upon the subject have from time to time been advanced. Khittel, in 1858, regarded the poisonous principle a volatile alkaloid; Maisch, in 1865, believed it a volatile acid; while Burrill at one time thought a bacterial germ might be the responsible agent. However, none of these observers has made a very satisfactory case, and it is accordingly a matter of more than ordinary interest that the poisonous principle has at length been isolated by Dr. Franz Pfaff, of the Harvard Medical School. As Dr. Pfaff's preliminary article[1] upon the subject is published in a medical journal and may, therefore, escape the notice of biologists who are not also physicians, his results may be summarized in these columns.

After a résumé of the investigations on Rhus poisoning, the fact is pointed out that skin irritants are, in general, rapid or slow in their action according as they are more or less volatile. In the case of Rhus poisoning the latent period between exposure and the first symptoms of dermatitis, is a comparatively long one, amounting often to several days. This would suggest that the poison is not a volatile substance but something of a more fixed nature. However, as the prevailing opinion strongly favored the idea that Rhus poison pervaded the air in the neighborhood of the plant, Dr. Pfaff first proceeded to extract by steam distillation Maisch's " toxicodendric acid," which after combination with barium and sodium was found to be nothing more nor less than acetic acid. He then tried quite a different plan and by distilling alcoholic extracts of *Rhus toxicodendròn* and *R. venenata* he obtained a black oily residue, which when purified gave an oil of agreeable odor. This oil was readily soluble in alcohol, ether, benzol, etc., but insoluble in water. On prolonged exposure to air it turned to a resin. The effects of the oil, for which the appropriate name *Toxicodendrol* is suggested, were repeatedly tried upon the persons of several assistants and others offering themselves as subjects. In all cases it proved a most active skin irritant, producing, even when applied in very small quantities, highly characteristic cases of Rhus poisoning. There can, therefore, be scarcely a doubt that the true principle has now been discovered.

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[1] Journal of Experimental Medicine, II, 181–195, t. 10.

Notwithstanding the popular impression that a volatile poison eminates from the Rhus, which thus acts upon sensitive persons even at a distance, no signs of such action have been detected by Dr. Pfaff and his assistants. Although they have experimented upon many pounds of fresh *R. toxicodendron* and *R. venenata*,, no case of poisoning has occured except after actual contact with the plants or with objects which the plants have touched. Dr. Pfaff suggests that the pollen may at the time of anthesis act as a transporting agent, but that the popular opinion has probably arisen through frequent cases of poisoning by unconscious contact with the plants or with clothing or other objects to which the viscid oil has adhered. The extended latent period, of course, adds greatly to the difficulty of eliminating such possibilities in particular cases. The practical outcome of Dr. Pfaff's discoveries is that we may now have an intelligent treatment in cases of Rhus poisoning, and he points out that the best remedy at all stages is the very simple one of removing the irritant by thoroughly brushing the affected parts with soap and water, while on the other hand, the application of oils, vaseline, or even alcohol, if not at once removed, only serves to spread the poisonous principle, since it is readily soluble in these media.

The newly discovered toxicodendrol appears to be present in all parts of the plant, even in the roots. Old and dried stems also yielded it. No difference has as yet been detected between the oil extracted from *Rhus toxicodendron* and that from *R. venenata.* Successful analyses have not yet been made, but further investigations along these lines are in progress in Dr. Pfaff's laboratory. It is to be hoped that he will extend his researches to other species of Rhus, notably *R. pumila* Michx., concerning which there has been considerable controversy, some writers maintaining its innocence, others its extreme virulence.—B. L. ROBINSON.

Botany in Detroit.—The botanists appeared to share the feeling of many other scientific men that it was inadvisable to hold a separate meeting of the American Association for the Advancement of Science, preferring to arrange for a joint meeting with the British Association which met a week later in Toronto. At any rate, the botanists pretty generally did not go to Detroit. When Section G organized on Monday forenoon, there were in addition to the Vice-President and Secretary but three duly qualified members who were eligible to appointment upon the sectional committee, and it was not until the second day that all the committees were filled. And yet in spite of this discouraging beginning, the sessions were interesting and profitable.

Vice-President Atkinson delivered his address upon "Experimental Morphology" on Monday afternoon, August 9th, detailing with some particularity the results of his experiments upon ferns of the genus Onoclea, in which by mutilation at certain periods he was able to bring about the transformation of the sporophyll into a normal or nearly normal foliage leaf. The possibility of applying experimental methods to the solution of many morphological problems was discussed at some length.

The following papers were presented, some in extenso and others by title only.

Trillium grandiflorum, its variations, normal and teratological, by Charles A. Davis.

A discussion of the structural characters of the order Pezizinæ of Schroeter, by J. E. Durand.

The taxonomic value of fruit characters in the genus Galium, by K. E. Wiegand.

Report upon the progress of the botanical survey of Nebraska, by Charles E. Bessey.

Changes during winter in the perithecia and ascospores of certain Erysipheæ, by B. T. Galloway.

The Erysipheæ of North America, by B. T. Galloway.

Some contributions to the life-history of Haematococcus, by L. R. Jones.

Bacteriosis of Carnations, by Albert F. Woods.

Wakker's Hyacinth bacterium, by Erwin F. Smith.

Notes on some new genera of fungi, by George F. Atkinson.

Are the trees receding from the Nebraska plains?, by Charles E. Bessey.

Reproductive organs and embryology of Drosera, by C. A. Peters.

Development of some seed-coats, by J. O. Schlatterbeck.

Contributions on the wild and cultivated roses of Wisconsin and neighboring States, by J. H. Schuette.

Morphology of the flower of *Asclepias cornuti* by Fanny E. Langdon, presented by V. M. Spalding.

Comparison of the pollen of Pinus, Taxus and Peltandra, by George F. Atkinson.

Some characteristics of the foothill vegetation of western Nebraska, by Charles E. Bessey.

On the distribution of starch in woody stems, by B. Shimek.

Mechanism of root-curvature, by J. B. Pollok, presented by V. M. Spalding.

The toxic action of phenole in plants, by R. H. True and C. G. Hunkel.

Cellulose ferment, by F. C. Newcombe.

Is the characteristic acidity of certain species of the Arum family a mechanical or a physiological property or effect, by Charles P. Hart.

How plants flee from their enemies, by W. J. Beal.

Stomata on the bud-scales of *Abies pectinata,* by A. P. Anderson.

Comparative anatomy of the normal and diseased organs of *Abies balsamea* affected with *Aecidium elatinum,* by A. P. Anderson.

On a new and improved self-registering balance, by A. P. Anderson.

Several other papers were presented, the titles of which were not obtained, and two hours were given to a joint session with the Zoological Section in the discussion of Organic Selection as presented by H. F. Osborn.

In the Botanical Club, it was found on assembling, that President, Vice-President and Secretary were absent; accordingly J. J. Davis was elected President, and Albert F. Woods, Secretary. The following notes were presented:

An epidemic of *Erysiphe communis* on *Polygonum aviculare,* by Charles E, Bessey, noting the universal presence of this parasite upon the host mentioned in eastern Nebraska in 1897.

A phosphorescent mosquito (Chironomus sp.), by Charles E. Bessey, noting phosphorence upon all parts of the insect which, while living, was evidently suffering from some disease. No hyphæ or bacteria were found after careful examination, although the presence of the latter is suspected.

Photographs of the Botanical Gardens of the Michigan Agricultural College were shown by W. J. Beal.

Charts of fungi and large sheets of preparations of weeds, to be used in botanical lectures before distant audiences were shown by W. J. Beal.

Dicranum spurium and some other mosses, by R. H. True, noting certain structural peculiarities.

Sensitive stamens in Opuntia, by Charles E. Bessey, (*O. fragilis* and *O. missoouriensis*).

Some south Michigan Oaks, by Messrs. Britton and Wheeler, being the report of a committee which visited some oaks near the city. The trees in question *may* belong to the species *Quercus texana* and *Q. michauxii*, but further study is necessary.

On a method of preserving chlorophyll-bearing tissues, by A. F. Woods. After precipitating the chlorophyll with copper, the material (as leaves, etc.) may be preserved indefinitely in glycerine jelly.

Why moss-capsules nod, by R. H. True, concluding that while the curvature is geotropic, the direction is influenced by light.

The botanical garden of the University of Michigan was spoken of by V. M. Spalding.

Frost injury to fruit trees and the falling of Ailanthus leaves were discussed by A. D. Selby.

Professor Conway MacMillan, of the University of Minnesota, Minneapolis, Minnesota, was elected President for the ensuing year.

Professor C. B. Waldron, of the University of North Dakota, Fargo, N. D., Vice-President.

A. B. Seymour, Harvard University, Cambridge, Mass., Secretary.

CHARLES E. BESSEY.

The Botanical Society of America held its third Annual Meeting in Toronto, August 17th and 18th. The address of the retiring President, Prof. C. E. Bessey, upon the Phylogeny and Taxonomy of the Angiosperms, will be published in full by the Society. The following papers were read:

B. L. Robinson: Ecblastesis in *Lepidium apetalum.*

J. C. Arthur: Movement of protoplasm in cœnocytic hyphæ.

J. M. Coulter: The pollen grain and the antipodal region.

D. P. Penhallow: Studies of the species of Picea.

H. J. Webber: The fertilization of Zamia.

D. T. McDougal and D. H. Campbell: Report upon the proposed tropical laboratory.

E. L. Greene: Bibliographical difficulties.

The following officers were elected for the ensuing year: President, Dr. N. L. Britton; Vice-President, Prof. J. C. Arthur; Secretary, Prof. C. R. Barnes; Treasurer, Arthur Hollick. The next meeting will be held in Boston just previous to the meeting of the American Association for the Advancement of Science.

Government Timber-tests.—The Division of Forestry of the United States Department of Agriculture issued some months ago a summary of mechanical tests on thirty-two species of American woods (Circular 15) which is worthy of something more than a passing remark. These tests were made in St. Louis, Mo., by Professor J. B. Johnson. This work has been carried on for six years, resulting in the collection of a great deal of valuable information in regard to the timbers investigated. The work thus far has been very carefully done, and the results cannot but prove of the greatest value to engineers and others who make use of timber for large constructions. It is a pity that the Chief of the Division has to say "at the present writing all work in timber-testing has been abandoned." It is to be hoped that the Secretary of Agriculture will make strenuous efforts to secure the means for continuing the work. Certainly our American timbers are worthy of being carefully studied, and having their values rated in standard works on the strength of materials. A Secretary who wishes to bring things American to the favorable notice of the world could not do it more certainly than by securing the exact data demanded by engineers as to the value of our native timbers.—Charles E. Bessey.

Notes.—J. M. Greenman, of the Gray Herbarium of Harvard University, contributes three papers to the Proceedings of the American Academy of Arts and Sciences (Vol. XXXII, No. 16), namely, a Revision of the Mexican and Central American Species of Houstonia, a Key to the Mexican Species of Liabum, and Descriptions of new or little-known Plants from Mexico.

Among the recent papers on mosses is an important one by J. Cardot on the Mosses of the Azores and of Madeira, in the Eighth Annual Report of the Missouri Botanical Garden. It includes twenty-four pages of text, consisting of an annotated catalogue with descriptions of new species, and eleven plates.

Dr. J. C. Arthur's bulletin (65, Purdue) on Formalin for prevention of Potato Scab, shows that by the use of this substance " seed-potatoes " may be practically freed from scab germs by an immersion for two hours in a solution of the approximate strength of 1:300.

In a recent number of the Journal of School Geography, Professor Conway MacMillian contributes some useful notes for teachers on the Geographical Distribution of Plants. Copies can probably be obtained of the author by addressing him at the University of Minnesota.

Professor G. B. Frankforter, of the University of Minnesota, has begun the chemical study of the common poke-weed (*Phytolacca decandra*), and has published the first part of his results in the American Journal of Pharmacy. Among the results thus far obtained is the remarkably high per cent. (41.62) of potassium oxide found in the ash.

From the Experiment Station Record we learn that the following amounts were included in the Congressional appropriations for the United States Department of Agriculture for the fiscal year 1897–8, viz.: Division of Botany, $23,800 ; Division of Agrostology, $18,100 ; Division of Forestry, $28,520 ; Division of Vegetable Physiology and Pathology, $26,500. This is hopeful ; nearly $100,000 for the study of some phase of botanical science ! But one is disappointed in finding that Congressmen have wasted $130,000 for a free distribution of seeds. We hoped that the day of this unwisdom had passed.—CHARLES E. BESSEY.

ZOOLOGY.

A List of the Birds of the Vicinity of West Chester, Chester Co., Pennsylvania.—(*Continued from page 814.*)—

106. *Dendroica æstiva* (Gmel.), Yellow Warbler. Rather common summer resident, but more abundant during the migration period. (Earliest spring occurrences : May 5, 1888 ; May 14, 1889).

107. *D. cœrulescens* (Gmel.), Black-throated Blue Warbler. Abundant migrant. (Spring occurrences : May 14, 1887 ; May 9–12, 1888 ; May 11, 1889 ; May 9, 1891. Fall occurrences : Sept. 7–29, 1889 ; Sept. 23 to Oct. 5, 1890).

108. *D. coronata* (Linn.), Myrtle Marbler. The most abundant migrant of the family, unless *Compsothlypsis americana* should be assigned

that position. (Spring occurrences: April 19, 1886; May 7, 1887; May 4–19, 1888; May 3–17, 1890; April 22 to May 9, 1891. Fall occurrences: Oct. 12, 1889; Oct. 18, 1890).

109. *D. maculosa* (Gmel.), Magnolia Warbler. Common migrant in the spring and fall. (Spring occurrences: May 9–15, 1888; May 14, 1889; May 10–17, 1890; May 9, 1891).

110. *D. cærulea* (Wils.), Cærulean Warbler. Very rare migrant. I shot a female in a swamp in West Goshen, May 10, 1890 (now in collection Acad. Nat. Sci. Philada.). I believe this to be the only published record of this species in eastern Pennsylvania, with the exception of one recently secured in Delaware Co. Dr. B. H. Warren claims ("Birds of Pennsylvania," 2d ed., 1890) to have seen five individuals in this part of the State, but since he does not mention to have taken specimens, the identity of these cases must be questioned.

111. *D. pennsylvanica* (Linn.), Chestnut-sided Warbler. Abundant migrant in the spring and fall. (Spring occurrences: May 7, 1887; May 9, 1888; May 11, 1889; May 10–17, 1890; May 9, 1891).

112. *D. castanea* (Wils.), Bay-breasted Warbler. Infrequent migrant. I shot a male on May 11, 1889, and a male and female May 17, 1890, also a bird of the year Sept. 17, 1890.

113. *D. striata* (Forst.), Black-poll Warbler. Common migrant in the spring and fall. (Spring occurrences; May 17, 1887; May 9–27, 1888; May 11–14, 1889; May 17, 1890; May 8, 1891).

114. *D. blackburniæ* (Gmel.), Blackburnian Warbler. Tolerably common migrant in the spring and fall. (Spring occurrences: May 5–19, 1888; May 4, 1891; May 7, 1897. Fall occurrences: Aug. 28, 1888; Sept. 19, 1890).

115. *D. virens* (Gmel.), Black-throated Green Warbler. Abundant spring and fall migrant. (Spring occurrences: April 28 to May 12, 1888; April 25 to May 8, 1891. Fall occurrences: Oct. 7. 1887; Sept. 19–29, 1889; Sept. 19 to Oct. 5, 1890).

116. *D. vigorsii* (Aud.), Pine Warbler. Common migrant in the fall. (Fall occurrences: Oct. 1–8, 1887; Sept. 19, 1889; Sept. 17 to Oct. 18, 1890). No spring occurrences have been noted by me.

117. *D. palmarum hypochrysea* Ridgw., Yellow Palm Warbler. Rather infrequent migrant in the spring. I have never seen it in the fall. In April, 1891, I shot five specimens and saw a few others, and saw a single one April 25, 1897.

118. *D. discolor* (Vieill.), Prairie Warbler. Rather rare migrant, which I have seen only twice, on May 10, 1890, when I secured a female and saw two other individuals, and May 2, 1897.

119. *Seiurus aurocapillus* (Linn.). Oven-bird. Common summer resident, though more abundant during the migration periods. (Earliest arrivals: May 2, 1887; May 12, 1888; May 11, 1889; May 3, 1890; April 25, 1891. Bulk arrived: May 10, 1887; May 19, 1888; May 1, 1891).

120. *S. noveboracensis* (Gmel.), Water Thrush. I have collected only one specimen of this species, on May 10, 1890, in West Goshen.

121. *Geothlypis formosa* (Wils.), Kentucky Warbler. Infrequent summer resident. I shot a male July 29, 1888. It is considerably more frequent during the migrations.

120. *G. agilis* (Wils.), Connecticut Warbler. Infrequent migrant in the early fall; the only specimens I have found were two collected in 1889, on Sept. 20th and 28th, respectively, and I saw another on Sept. 25th (all in West Goshen).

123. *G. trichas* (Linn.), Maryland Yellow-throat. Common summer resident. (Earliest arrivals: May 9, 1888; May 3, 1890; April 24, 1891. Bulk arrived: May 7, 1887).

124. *Icteria virens* (Linn.), Yellow-breasted Chat. Infrequent summer resident. I noticed one on May 6, 1887, in West Goshen, and shot a pair (male and female) in Birmingham on July 6th of the same year. In the spring of 1897 I saw four pairs, the first of which arrived May 9th.

125. *Sylvania pusilla* (Wils.), Wilson's Warbler. Common migrant in the spring and fall. (Spring occurrences: May 18, 1886; May 12, 1888; May 10–17, 1890).

126. *S. canadensis* (Linn.), Canadian Warbler. Common migrant in the late spring and early fall. (Spring occurrence: May 19, 1888; May 11, 1889; May 10, 1890).

127. *Setophaga ruticilla* (Linn.), American Redstart. Abundant migrant in the spring and fall. (Spring occurrences: April 14 to May 17, 1886; May 7–13, 1887; May 12–19, 1888; May 10–17, 1890; April 28 to May 9, 1891. Fall occurrences: Aug. 11, 1886; Aug. 25, 1887; Sept. 20, 1889; Sept. 6–23, 1890).

128. *Anthus pennsylvanicus* (Lath.), American Pipit. Not uncommon, though of irregular occurrence in the fall and spring. (Earliest fall occurrence: Oct. 13, 1888. Latest spring occurrence: April 14, 1888, when I saw a flock of about 100).

129. *Galeoscoptes carolinensis* (Linn.), Catbird. Abundant summer resident. (Earliest spring arrivals: May 4, 1886; May 2, 1887; May 1, 1888; May 1, 1891; April 28, 1897. Bulk arrived: May 5, 1886; May 3, 1887; May 6, 1888; May 4, 1891. This species is more regu-

lar in regard to the time of its arrival than any other that I have observed.

130. *Harporhynchus rufus* (Linn.), Brown Thrasher. Common summer resident. (Earliest arrivals: April 25, 1886; April 23, 1887; April 28, 1888; April 20, 1889. Bulk arrived: April 26, 1887).

131. *Troglodytes aëdon* Vieill., House Wren. Abundant summer resident. (Earliest spring arrivals: April 22, 1886; April 27, 1887; March 31, 1888; April 17, 1891, Bulk arrived: April 29, 1887; April 4, 1888).

132. *T. hiemalis* Vieill., Winter Wren. Tolerably common winter resident. (Earliest occurrence: Sept. 25; latest occurrence, March 31).

133. *Certhia familiaris americana* (Bonap.), Brown Creeper. Tolerably common resident during the late fall, winter and early spring. (Earliest occurrence: Sept. 25, 1890. Latest occurrence: April 21, 1886).

134. *Sitta carolinensis* Lath., White-breasted Nuthatch. Common resident.

135. *S. canadensis* Linn., Red-breasted Nuthatch. A very infrequent migrant. I shot a female on April 27, 1889, and saw another individual on Sept. 29th of the same year; also a brightly colored individual on Oct. 17, 1896, and shot another April 28, 1897.

136. *Parus bicolor* Linn., Tufted Titmouse. Common migrant in the spring and fall.

137. *P. atricapillus* (Linn.), Black-capped Chickadee. Common winter resident, sometimes abundant.

138. *Regulus satrapa* Licht., Golden-crowned Kinglet. Common resident in the fall, winter and spring.

139. *R. calendula* (Linn.), Ruby-crowned Kinglet. Common migrant in the spring and fall.

140. *Turdus mustelinus* Gmel., Wood Thrush. Common summer resident.

141. *T. fuscescens* Steph., Wilson's Thrush. Not infrequent migrant. I have taken it only in the spring.

142. *T. ustulatus swainsonii* (Cab.), Olive-backed thrush. I have shot only two specimens of this species, on Sept. 9, 1887, and Sept. 2, 1895, both in West Goshen.

143. *T. aonalaschkœ pallasii* (Cab.), Hermit Thrush. Common migrant in the spring and fall. (Spring occurrences: May 17–21, 1886; April 2, 1888; May 11, 1889; April 15–28, 1891. In the fall it remains until about Nov. 15th).

144. *Merula migratoria* (Linn.), American Robin. Abundant summer resident. (Earliest spring arrivals: Jan. 26, 1887; Feb. 21, 1888; March 13, 1889; March 1, 1890; Feb. 24, 1891. Bulk arrived: March 13, 1887; March 10, 1888; March 14, 1889. Latest fall occurrences: Dec. 18, 1885; Nov. 25, 1887; Dec. 31, 1889; Nov. 1, 1890). To judge from these data, it would seem probable that a few remain through the mild winters.

145. *Sialia sialis* (Linn.), Bluebird. Common resident, but now not as numerous as at the commencement of the period of my observations. It migrates in severe winters.

—THOS. H. MONTGOMERY, JR., PH. D.

May 26, 1897, Wistar Inst. of Anat., Philada.

ENTOMOLOGY.

Scudder's Guide to the Orthoptera.[1]—Mr. Scudder has again placed the workers in systematic entomology under obligation to him, by the publication of an exceedingly useful manual of Orthoptera. This little volume consists of analytical tables, bibliographical notes, and a list of papers treating of North American Orthoptera. The scope of the work is well stated by the author in his preface as follows:

"The following tables and bibliographies are published, not as a finality, but for temporary use by students of Orthoptera in this country, who have few means for working up their collections. The author contemplates a general work on the classification of our Orthoptera, of which this is merely a prodromus, and which may serve its purpose until the material at hand has been more thoroughly studied; the frequent demands made for information have prompted it. The greater number of tables are based upon those of Stal, Brunner and de Saussure, but these authors are in no way responsible for the form in which they here appear."

The work will be warmly welcomed by all having collections of Orthoptera. For the first time, it is now possible for one not a specialist in the Orthoptera, to determine the North American genera of all families of this order.

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[1] Guide to the Genera and Classification of the North American Orthoptera found north of Mexico. By Samuel Hubbard Scudder. Cambridge, Edward W. Wheeler, 1897, 8vo, pp. 89, $1.00.

If the appearance of the more general work is to be long delayed, which is probable, owing to the magnitude of the undertaking, it is to be hoped that Mr. Scudder will soon give us a catalogue of the known North American species of this order. Such a catalogue, even though it were merely provisional, would be of great use to those having collections to arrange, and would stimulate more careful collecting in regions which have not yet been thoroughly explored. In this way much would be done to hasten the day when a fairly complete general work could be published.

One has only to consider the great usefulness of our lists of Lepidoptera to appreciate the value of even an imperfect catalogue. And there is no one else so well qualified as is Mr. Scudder to prepare a catalogue of the Orthoptera.—J. H. C.

PSYCHOLOGY.[1]

Notes on the Experimental Study of Memory.[2]—The experimental investigation of memory began only a few years ago. In the books on modern psychology which date ten years back, there was no mention of it whatever. Wundt's treatise on physiological psychology, which may rightly be considered a typical work, devotes but very few pages to memory and not a word to experiments upon this faculty; nevertheless, this is a work which has passed through several editions, in which the author has endeavored to keep abreast with the science. The first investigators who directed their attention to the subject were Galton, Jacobs and Ebbinghaus; their studies were confined to a few points, and there still remain to-day many unexplored regions in this domain. The memory of sensations is merely outlined, and the memory of ideas still remains to be covered, at least for the most part. However, within the last two years, attention has been turned in the direction of the memory. Münsterberg, Calkins, Bigham, Müller and Schumann and many others have already published results which are exceedingly interesting, although still fragmentary. As it is certain that these studies are more likely than some others to render great service to pedagogy, it is to be hoped that the movement already begun will not be arrested too soon.

[1] Edited by Howard C. Warren, Princeton University, Princton, N. J.

[2] Translated and slightly abridged from the *Année Biologique*.—H. C. W.

The experiments on memory, whether made collectively on an assemblage of persons, as (*e. g.*), on an entire class of students, or individually upon single subjects, or again on the experimenter himself, who serves as his own subject—these experiments, I say, consist chiefly in giving the subject a certain impression, and then seeking to find out what becomes of this impression in his memory at the end of a certain time. The experimenter endeavors above all to take account of the greater or lesser transformation which the memory causes the impression to undergo. To discover this, three principal methods are employed.[3]

1. *Method of reproduction.*—This consists in making the subject *reproduce* his impression; if it is a story that he has listened to, he repeats or writes it; if it is a visible form, he sketches it; if it is a sound or an inflection, or some visible movement, he imitates it; if it is a color, he reproduces it by mixing the tints on a palette or varying the sectors of rotating discs. This is certainly the most natural method, in that it follows closely our ordinary procedure; but as a method of studying the memory it is somewhat indirect; it requires a translation or transposition of the impression, and a special aptitude, *e. g.*, in sketching or painting; it should, therefore, be expressly reserved for the verbal memory. 2. *Method of selection.*—This consists in the recognition of the impression when it is presented again in company with others; thus a tint is exhibited at first and the subject must remember it; at the end of a certain time he is shown a graded series of the same color, comprising fifteen different tints, and must recognize the one which was shown him before; the second presentation may give the whole series simultaneously or successively. This method is simpler than the preceding, since it bears more directly on the memory; there remains to consider the sources of error which it contains. One has already been noted. Whenever we have to make a choice from among a set of objects our attention is drawn towards the centre of the series; if the impression to be recognized is the sixth in a series of 15, the seventh impression is more apt to be indicated than the fifth, because the former is nearer the centre; consequently the arrangement of the series, that is, the application of the method, exerts some influence upon the character of the results. 3. *Method of comparison.*—The subject compares the remembered impression with another impression which is shown him, and answers that the latter is "equal, greater or smaller."

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[3] This classification of the methods for the study of memory was first proposed by V. Henri and myself; Baldwin has arrived at analogous methods quite independently.

Thus if it is a line that he is to remember, he is shown another line and judges the relation of the two.

These two methods may be used with many variations of detail into which we need not enter; it is sufficient to have shown that it is possible to make an experimental study of memory. I shall proceed to indicate the principal results which have up to the present been reached by science. There is, perhaps, no question of more importance to pedagogy. As I can only give a bird's-eye view of the whole, I will not mention any name, nor will I enter into the details of any experiment; it is sufficient to sum up in a few bare statements the results that have been attained.

1. *Partial memories.*—We know to day that the memory is not a unit, but that there exists for each individual a series of partial memories which are distinct and independent; that these memories are unequally developed, and that in a certain number of pathological cases one of the memories may disappear altogether, leaving the rest intact or nearly so. The most striking example of this that can be cited is aphasia, a disorder in which the memory and images of words are affected in a special manner; the patient usually retains the memory and images of objects, and remains in possession of his intellect. Examples of the partial development of memory are met with among some professional exhibitors, such as chess players and (more especially) lightning calculators.

2. *The measurement of memory.*—Although the methods used for measuring the memory may have been crude, as they still are, it is nevertheless a great advance to be able to introduce the concept of measurement into this problem at all. So far attempts have been made to measure but one kind of memory, the direct faculty of acquisition. The experiments deal with the number of memory-images that can be stored up at a single trial, without allowing the subject time to rest. This is called in English the " mental span " of the memory; I have proposed for it the term " faculté de prehension." Several successive investigations have already been made on the measurement of the memory for figures and syllables; these are localized memories, the development of which cannot be considered as a sign of the development of the other memories: we must, therefore, make many reservations in interpreting the conclusions to be drawn from these experiments. The experiment may be made as follows: a series of figures is read to the subject at a regular speed (the speed used is in general two figures per second) and without any special accentuation; as soon as he has heard the series, the subject, having been told beforehand of

the requirement, endeavors to repeat the figures without error and in the order in which he heard them. The experiment is repeated several times, beginning with a small number of figures, *e. g.*, four, which any adult can give correctly; it is then increased to five figures, then to six, and so on, until a number is reached which the subject can no longer repeat correctly; care is taken to repeat each trial, and to allow sufficient intervals of rest to avoid fatigue and the confusion of figures in the memory. This procedure, adopted by Jacobs, Galton and many others, has already borne fruit. It is not, properly speaking, a test of the memory alone; it is extremely difficult, be it said in passing, to experiment on any isolated psychological phenomenon; the experiments taken together show, on the contrary, that the subject employs not only his memory but also his powers of voluntary attention; this explains why children retain fewer figures by this method than adults; their inferiority is certainly due to the fact that they have less control over their attention. The average educated adult retains seven figures; a child from 6 to 8 retains five; a child of 10 retains six. A difference of one single figure is of considerable importance in the results, and it is one of the drawbacks of this method that we cannot operate with fractions of figures. I have had occasion to measure the retentive memory of Jacques Inaudi, the celebrated lightning calculator; he is able to commit more than 40 figures at one trial; it will be seen from this how far his memory is above the average.

Instead of finding out the number of figures, letters or words that can be retained by one person after a single hearing or reading, a different procedure may be adopted; we may endeavor to find the time required by different individuals to learn a given number of figures, say twelve; further, we may try to find the time necessary to learn again a series once learned and afterwards forgotten. For details in regard to these rather complex methods I refer the reader to the work of Ebbinghaus. (*Ueber das Gedächtniss*).

A rather curious question, which is closely related to that of the measurement of memory, is the *simulation* of the memory for figures. Memory can be simulated as well as other things. This is done by means of mnemonics, a process which consists in associating arbitrary ideas with figures; I have indicated, in a study undertaken with V. Henri, how real memory can be distinguished from simulated memory, by measuring the time required to learn and reproduce.

3. *Forgetfulness.*—We now reach a question that has an important pedagogical bearing: the problem of forgetfulness. In what does it consist? What is its course? What memories are attacked first?

What are the best means to adopt for preserving memory-images? What should be done in order to strengthen the memory, etc., etc.? On all these points there have accumulated within the last ten years a countless number of documents; no synthesis of these data has yet been made, and I know of no general work in which the author has attempted to compare the results of these special studies and to draw forth their underlying principles; I except, of course, works on the mental pathology of the memory (Ribot, Sollier, etc.), which we are not concerned with here; I am only speaking of normal memory, studied with exactness by means of laboratory experimentation.

The analysis of these experiments leads us to one conclusion regarding the nature of forgetfulness. It is of two kinds, and is due to two principal causes: (1) *Forgetfulness through lack of retention;* the impression is not stamped in and does not leave a trace, this is the first kind; (2) *Forgetfulness through lack of reproduction;* the impression has been stamped in, but cannot be brought out or reproduced at will. *e. g.*, 100 words being read to a person, how many does he forget? The answer varies according to the way in which the term forgetfulness is interpreted. If we ask the subject to repeat the words, he will perhaps not be able to give more than 20, hence he has forgotten 80—forgotten them, in the sense that he cannot repeat them. This number can, therefore, be placed to the credit of forgetfulness through lack of reproduction. Now if we take these 80 words which the subject cannot repeat and mixing them up with one or two hundred new words, ask him to distinguish the old from the new words, we will see that he makes a very small number of errors; I suppose that on the average 60 words will be recognized out of 80, so that in the end there are scarcely 20 words in 100 (and, perhaps, even fewer) that are completely forgotten; the others were retained, inasmuch as they were recognized. *The amount of forgetfulness through lack of retention is always small.*

The position of the forgotten elements in a series of memories appears to be quite regular; the first elements in the series are almost always better retained than the rest, no doubt because they strike the attention when it is fresh; the same is true of the last elements, no doubt because they are the ones acquired most recently; most of the forgotten elements, then, belong to the centre of the series. The influence of novelty, repetition and other factors on forgetfulness have been studied (Calkins), as well as the influence of the time elapsed (in numerous investigations), the organ stimulated, the attention, distraction, etc. These investigations, many of them minute, have furnished us with matters of detail, rather than general ideas.—ALFRED BINET.

SCIENTIFIC NEWS.

A Statement to the Corporation from the Trustees of the Marine Biological Laboratory.—The annual meetings of the corporation will hereafter be held at Woods Holl in August, instead of Boston in November, and absent members can now vote by proxy. The board of trustees has been enlarged to twenty-seven members, and the new board, it is believed, fairly represents nearly all sections of this country and Canada. The closer co-operation of all institutions of learning is now actively encouraged.

These changes will make possible the attendance of a large number of members at annual and special meetings, who have been unable to reach Boston during the month of November, and there are already signs of increasing interest in the institution over a much wider area. The members will be glad to learn that, at the recent meeting of the British Association in Toronto, Dr. Dohrn, Director of the unrivalled station at Naples, took occasion to speak as from personal knowledge in terms of warm commendation of the work at Woods Holl. The past summer has been highly satisfactory; but the trustees have been hampered by lack of funds for needed repairs and renewals, and, to some extent, for current expenses. At least $1,000 should be raised before resuming work next summer, and there remains a debt of about $4,700 incurred for the erection of new buildings. This debt should be cancelled in order that a clear balance sheet may be shown before undertaking several most desirable extensions of the plant, some of which are urgently needed. Salaries should be increased and greater inducements offered to the strong corps of instructnrs and workers, whose collaboration has enabled the institution to attain its present position in the scientific world. Moreover, there is no assurance of permanence in an institution of this nature, until it shall have acquired a sufficient endowment or maintenance fund, independent of its land, buildings and equipments (which now represents an investment of over $33,000), to relieve it from danger of extinction by one or more seasons of small attendance. The endowment fund now amounts to over $3,500, and has been carefully husbanded; but it should be increased to at least $50,000, and the special funds, the Lucretia Crocker Fund for scholarships and the library fund, may profitably be added to.

One effect of the recent changes in the by-laws will be, or may be, to diminish the special interest in and sense of responsibility for the laboratory heretofore shown in the city of Boston and its immediate vicinity, to which, as is well known, the institution owes its initial impulse and much continuous and generous support. In appealing, as they do now, to a wider constituency, the trustees are in nowise unmindful of the debt which the cause of science and of sound learning owes to this intelligent and kindly support in the past, some of which support, as they are assured, will hereafter be extended, with unwearied generosity, from the same locality. The laboratory now looks to the country at large for its main source of income. Upon all the corporate members, in whose hands the recent changes have placed the entire control, now rests the correlative duty of supporting the work. With power comes responsibility.

The trustees, therefore, have decided to raise the annual dues of members of the corporation to two dollars ($2). The fiscal year now begins in the second Tuesday in August, and this sum is now due for the year ending August 9, 1898. Members of the corporation will kindly forward it, together with all back dues, to the Treasurer, *D. Blakeley Hoar, 220 Devonshire St., Boston, Mass.*

For the reasons above given, the trustees also appeal to the members of the corporation to send, with their annual dues, such further sums, however small, as the means and interest of each in the work may inspire. All contributions will be duly noted in the annual report, which is in course of preparation, and will be issued early in the coming year. A contribution of not less than $100 entitles the donor to a life membership, exempt from annual dues, or at his option, to nominate a person to occupy a private room in the Laboratory, free of charge, during one season. A contribution of $50 entitles the donor to a free scholarship, exempt from tuition fees, during one season. Contributions of smaller amounts will be gratefully received and duly acknowledged.

The forth-coming report will show fully all the recent changes in the organic law of the Association, and will be sent to all members in good standing.

By order of the Trustees,
H. C. Bumpus, *Secretary,*
Edward G. Gardiner, *Chairman,*
D. Blakely Hoar, *Treasurer,*
Camillus G. Kidder,
Henry F. Osborn, *President,*
James I. Peck, *Asst. Director,*
C. O. Whitman *Director,*
Executive Committee of Trustees.

All matters relating to the scientific administration of the Marine Biological Laboratory should be addressed to Prof. C. O. Whitman, University of Chicago, Chicago, Ill.; all applications for membership to the Secretary, Prof. H. C. Bumpus, Brown University, Providence, R. I.; all dues and subscriptions to the Treasurer, D. Blakeley Hoar, 220 Devonshire St., Boston, Mass.

Recent Appointments: Dr. Frech, professor of geology in the University of Breslau; Dr. Paul Samassa, professor extraordinary of zoology at Heidelberg; Dr. E. B. Copeland, assistant professor of botany in the University of Indiana, Bloomington, Ind.; Dr. G. Boccardi; associate professor of histology at the University of Naples; Ernest B. Forbes of the University of Illinois, assistant state entomologist of Minnesota; Dr. James E. Humphrey, associate professor of botany in Johns Hopkins University; Dr. George B. Shattuck, assistant in geology in Johns Hopkins University; Dr. Charles E. Beecher, advanced to University, professor of historical geology and Dr. L. V. Pirsson, professor of physical geology in Yale University; Miss Bertha Stoneman, professor of botany in the Huguenot College for Women in Cape Colony; J. L. Prevost, professor of physiology in the University of Geneva; Dr. J. J. Zumstein, professor of anatomy in the University of Marburg; Dr. H. Baum, professor of osteology in the Technical High School at Dresden; Dr. W. Ule, professor of geography in the University of Halle; Dr. A. O. Kihlmann, assistant professor of botany at Helsingfors; Dr. Alex. Bittner, chief geologist; G. Geyer, geologist, G. von Bukowski and August Rosiwál, adjunct, Drs. J. Dreger, F. von Kerner, J. J. Jahn and F. Eichluter, assistants of the imperial Austrian Geological Anstalt at Vienna; Dr. Karl Toldt, professor of anatomy, has been elected Rector of the University of Vienna for the coming year; W. Garstang, naturalist of the Plymouth (England) Laboratory; Dr. E. Kaufmann, professor of anatomy at Breslau; Dr. Max Walters, professor of anatomy at Bonn; W. H. Lang, lecturer in botany in Queen Margaret College, Glasgow; Dr. Walter Kruse, professor of hygiene at Bonn; Dr. Raphael Slidell, professor extraordinarius of zoology at Heidelberg; Prof. Johannes Ruchert, professor of anatomy in the University of Munich; Miss D. Clark, demonstrator in botany, Queen Margaret College, Glasgow; Freiher von Erlanger, professor extraordinarius of zoology at the University of Heidelberg; Dr. George J. Pierce, professor of plant physiology in Leland Stanford University; Miss M. Maclean, demonstrator in anatomy, Queen Margaret College, Glasgow; Prof. C. L. Herrick, lately professor of biology in Denison University, has been elected President of the University of New Mexico at Albuquerque; Miss Arma Anna

Smith, assistant in botany in Mt. Holyoke College; Prof. Ph. Stöhr, of Zürich, professor of anatomy in the University of Würzburg, Prof. von Kölliker restricting himself to histology and embryology; Prof. Hugo de Vries of Amsterdam, professor of botany in the University of Würzburg, as successor to the late Prof. Sachs; Dr. H. Fling, professor of biology and chemistry in the Oskosh Normal School; Dr. Bruno Hofer, director of the institute for the study of diseases of fishes at Munich; Henry Kraemer, professor of botany and microscopy in the Philadelphia College of Pharmacy; Dr. Albert Schneider, professor of botany in Northwestern University, Evanston, Ill.; Dr. Jumelle, assistant professor of botany in the faculty of sciences at Grenoble, France; Johannes Martin, Director of the Natural History Museum in Oldenburg; Dr. Philippi, assistant in the Museum of Natural History in Berlin; T. I. Pocock, assistant geologist on the British Geological Survey; Dr. W. F. Hume and L. Gorringe, assistants on the geological Survey of Egypt; Dr. H. V. Neal, professor of biology in Knox College, Galesburg, Ill.; Prof. George Ruge, to the chair of anatomy at Zürich, as successor to Prof. Stöhr; Dr. Ossau of Hiedelberg to the chair of mineralogy in Mülhausen; Dr. J. Büttikofer of Leiden, director of the zoological gardens at Rotterdam; Dr. Antoneo Crocicha, professor of biology in the Catholic University at Washington; Adolf Beck, professor of physiology at Lemburg; Dr. Ludwig Heim, professor ext. of bacteriology at Erlangen; Dr. H. Baum, professor of osteology at the Dresden Technical School; Dr. George Volkens, assistant in the Botanical Museum at Berlin; Dr. A. O. Kihlman, professor extraordinary of botany at Helsingfors; W. S. Boulton, of Mason College, lecturer in geology at University College, Cardiff, Wales.

James Ellis Humphrey, the son of James and Susan (Cushing) Humphrey, was born in Weymouth, Mass., August 5, 1861. He received his early education in the Weymouth schools, and at the early age of sixteen was appointed master of one of the grammar schools in his native town. Then after a short experience in the Prang Educational Company, he entered the Lawrence Scientific School of Harvard University, from which he received the degree of S. B. in 1886. During his college studies he paid especial attention to botany, and immediately upon graduation he received an appointment as assistant in the botanical laboratories under Professor G. L. Goodale In 1887 he was appointed instructor in botany in the University of Indiana, and the next year he accepted the position of botanist in the State Agricultural Experiment Station at Amherst, Mass., where he remained until 1892. While at Amherst he continued his studies under

JAMES ELLIS HUMPHREY.

See page 920.

the direction of the Harvard Faculty, and in 1892 received the degree of Sc. D. from his alma mater. This same year he spent three months in Jamaica collecting botanical material. He then went to Germany where he studied until 1894 under Professor Edouard Strasburger at Bonn. Upon his return to America he was made a fellow in the Johns Hopkins University, and the next year received an appointment as lecturer in botany in that institution. This present year he was advanced to the position of associate professor of botany. In early June, he sailed with a party of Johns Hopkins students to Jamaica, where the Johns Hopkins marine laboratory was established for the summer. The work was most successful and Professor Humphrey obtained some most important material upon the embryology of the palms and of ginger. On August 12 he was taken sick, but his condition was not considered at all serious until the 17th, when he rapidly grew worse, dying the same day of pernicious malarial fever.

Early in his botanical career, Dr. Humphrey became interested in the study of the Algae, and his first published paper (his thesis for the degree of S. B.) was on the development of the frond of *Agarum turneri*, in which he explained the method by which the peculiar perforations found in that species are formed.

Upon his removal to Indiana and later to Amherst, it became necessary to pay especial attention to the fungi, and more particularly to those which cause plant diseases. His reports as botanist to the Amherst Experimental Station include valuable papers on the black-knot of the plum, on diseases of cucumbers and potatoes, and on other kindred diseases. More important and more elaborate than these was his dissertation for the doctor's degree, a monograph of the Saprolegniaceæ, which will long remain a classic upon this subject.

Naturally, upon his introduction to Strasburger's laboratory, his studies took a cytological turn and his several papers upon the cell and cell-contents were published in the *Berichte* of the German Botanical Society and in the *Annals of Botany.* For many years he furnished abstracts of American botanical work for the *Botanische Centralblatt*, and he also translated and edited Zimmermann's " Botanical Microtechnique."

Personally, Dr. Humphrey was straightforward and outspoken, and little inclined to tolerate what seemed to him inferior work. The work he had already done showed what might have been expected of him in the future, connected with a university with whose scientific staff he was in full sympathy, and upon whose students his enthusiasm and his sincerity were already producing happy results. He was very optimistic and had the happy faculty of believing that the future would turn out well, whatever the discouragements of the moment.

To his older botanical friends his sudden death at an age when so much was hoped from him for years to come, is a great shock, and they recall vividly his many sterling qualities as well as his capacity as a botanist. To us, connected editorially with the AMERICAN NATURALIST, his loss is a severe one, as he had made all arrangements to act as one of the editors of this magazine.

Recent deaths: Dr. Alfred Stocquart, chief demonstrator of anatomy in the University of Brussels; Dr. Legros, professor of physiology in the same university; H. V. Carter, professor of anatomy and physiology in Grant College, Bombay; E. Russow; former professor of botany at Jurjiew, April 23d, aged 56; Lucien Biart, naturalist and collector, in Mexico; L. Jurani, professor of botany in the Royal University of Hungary, Feb. 27th, aged 59; C. J. M. Bugnion, entomologist, at Lausanne, Jan. 19th, aged 86; Mrs. Alice Bodington, a well-known contributor to the American Naturalist, at New Westminster, British Columbia; H. D. Achon, coleopterist, at Orleans; Leon du Pasquier, professor of geology and paleontology in the Neuchatel Academy, in April, aged 33; V. Maurice Teinturier, coleopterist, in Clayeures, France; Madame Jean Dollfus, editor of *La Feuille des jeunes Naturalistes;* Edmund Neminar, formerly professor of mineralogy and petrography in the University of Innsbruck; Victor Lemoine of Rheims, paleontologist; Karl Kolbel of the Vienna Hofmuseum, student of Arthropods, at Ponape, Caroline Islands; Alexis Jordan, botanist, at Lyons, France, Feb. 7th, aged 83; J. B. Hodgkinson, entomologist, Ashton on Ribble, England, Feb. 17th, aged 73; Fr. Wilh. Klatt, botanist, at Hamberg, March 3rd; Geo. W. Traill, marine algologist: Alex. N. Kortschagin, curator of the zoological museum at Moscow, Feb. 7th; Alfred Dewevre, botanist, Feb. 27th in Congo State; Friederick Seelig, ichthyologist, in Cassel, March 18th; Prof. Hermann Friederich Kessler, student of Aphides, in Cassel; Hugh Nevill, collector and naturalist, at Hyères, France, April 10th; Heinrich Waukel, Anthropologist, in Olmutz, aged 76; Emile Magitot, President of the Anthropological Society of Paris; Joseph Ewing Macfarland of the U. S. Geological Survey, in Baltimore; Sir Augustus Wollaston Franks, a well-known archæologist and trustee of the British Museum, May 21st, aged 71; W. Preyer, professor of physiology, at Wiesbaden, aged 56; Professor Chudzinski of the Paris School of Anthropology; Frederick C. Straub, botanical collector in Liberia, Africa, March 21st, aged 26; Sir John Bucknell, neurologist, at Bournemouth, England, July 20th, aged 79; Dr. J. Hammond Trumbull, student of American linguistics, at Hartford, Conn., Aug. 5th, aged 76; Capt. Bertram Lutley Sclater, African explorer, son of P. L. Sclater, at Zanzibar, July 24 aged 31; Dr. Alfred Moquart, professor of anatomy at Brussels on June 5th; Count Victor Trevisan, cryptogamist in Milan, April 8th.

For many years we have heard tales from the southwest regarding the "Enchanted Mesa" which in brief were to the following effect. Many years ago this table-land was inhabited by a tribe of Pueblo Indians, but a sudden catastrophe rendered the top of the mesa no longer accessible. To investigate this legend was one of the objects of Professor Libbey in his recent trip to New Mexico and we summarize the results of his ascent of the Mesa Encantada from the dispatches in the daily papers. The ascent was made July 23, 1897 and was successful in every respect. Ropes were thrown over the mesa by means of a cannon borrowed from the Life-Saving Service of the U. S. Government and by means of a boatswains chair the party were hauled to the top, 550 feet above the surrounding plain. The level top was about fifteen acres in extent, its sides being precipitous. No traces, whatever of former human habitation were found, the legend apparently being without any foundation. Here, however, there is room for a difference of opinion. In *Science*, for September 17, "W. S. M.," whose initials will readily be recognized, states that on September 3, 1897, Mr. F. W. Hodge, of the Bereau of Ethnology, scaled the mesa and found fragments of pottery, two broken stone axes, a stone arrow point and some other evidences of former occupancy.

Col. Theodore Lyman died at Nahant, Mass., Sept. 9, 1897. He was born at Waltham, Mass., Aug. 23, 1833, graduated at Harvard in 1855, and then spent three years in study under the late Professor Louis Agassiz. He served in the Union Army from 1863 to the close of the war. In 1865 he was appointed Commissioner of Fisheries in Massachusetts, a position which he held for 17 years, and in 1882 he was elected a representative in Congress. He was connected with many educational and philanthropic interests. In zoology he was largely interested in Echinoderms, and published several important papers upon the Ophiuroids, his chief work in this line being the large monograph of 400 pages and 48 plates in the Results of the "Challenger Expedition." For more than ten years he had been an invalid.

From *Science* we learn that the Berlin Academy of Sciences has made the following subsidies for scientific work. Prof. F. E. Schulze, to aid in the publication of Das Theirreich, Mk. 35,000; Prof. Engler, for publication of monographs on African botany, Mk. 2000; Dr. G. Lindau, for studies on lichens, Mk. 900; Prof. F. Frech, for geological studies, Mk. 1500; Prof. H. Hürthle, for studies on muscles, Mk. 850; Prof. R. Bonnet for work on blood vessels, Mk. 800; Dr. Lühe, study of the fauna of the salt lakes of Northern Africa, Mk. 2000; Dr. G. Brandes for studies on Nemertines, Mk. 300; Dr. R. Hesse for studies on eyes of lower invertebrates, Mk. 500; Prof. E. Cohen, study of meteorites, Mk. 1500; Dr. L. Wulff, for experiments on artificial crystals, Mk. 1500.

The first number of the Zoological Bulletin, edited by Whitman and Wheeler has appeared from the press of Ginn & Co., Boston. It contains four articles: E. P. Allis on the petrosal and sphenoid regions of Amia; C. W. Hargitt, experiments on regeneration in Cœlenterates; C. L. Bristol, the metamerism in Nephelis, especially as shown by the nervous system; G. Baur, a criticism and reply to the recent paper by Bumpus in so far as the latter denies the probability of the intercalation of vertebræ. The Bulletin is gotten up in the same shape as the Journal of Morphology. It is to be issued six times a year, each number containing at least fifty pages. The subscription price is $3.00 per annum. The title page gives a list of 73 well-known names as collaborators.

The Academy of Sciences of Berlin, offers a prize of 2000 marks for the best memoir upon the origin and characteristics of the different cereals during the past twenty years. The memoirs which may be written in German, Latin, French, English or Italian, must be submitted to the Academy on or before December 31, 1898. Another prize of 1000 marks, is offered by the Prince Jablonowski Society of Leipzig for the best memoir on the causes which produce and control the direction of the lateral axes of shoot and root systems of plants. The competing memoirs are due on or before November 30, 1900.

Dr. Franklin Story Conant died in Boston, Sept. 13, of pernicious malarial fever. He was a graduate of Williams College, and had just received the degree of Ph. D. from Johns Hopkins University, as well as the appointment to the Adam T. Bruce Fellowship in that institution. He accompanied the Johns Hopkins party to Jamaica this summer, and was taken sick on the return voyage. Dr. Conant's only published work was upon the Chætognaths, but he had other and important papers nearly ready for the press.

An expedition started from Sydney, Australia on June 2d, to bore into the coral reef of Funafuti. The expedition is supported by the mining department of the New South Wales government and by private subscriptions. In the light of the recent similar expedition of the Royal Society we cannot but think that they would have done well to have put the practical work of boring in the hands of an American familiar with the boring of gas and oil wells.

We would call the attention of those purists in terminology who would replace such names as Ellobius, Gymnura, Gyge, etc., because of similarity to Ellobium, Gymnurus, Gyges and the like to the advisability of changing Raja, Iza and similar names because of possible confusion with words like Rana, Ixa, etc. This seems to have been neglected by them in their attempts to introduce confusion into nomenclature.

Plans have been drawn for two additions to the American Museum of Natural History in New York City. One addition is for a lecture hall at the north end of the present structure to cost $150.000; the other a six-story addition to the west wing at an estimated cost of $400.000.

On July 6th Professor Albert von Kölliker celebrated his eightieth birthday and his fifty year jubilee as ordinary professor of anatomy. He was presented with an album with carved ivory and ebony covers containing the photographs of hundreds of scientific men.

The tenth annual winter meeting of the Geological Society of America will be held at McGill University, in the city of Montreal, on December 29, 30 and 31, 1897. Details of the meeting will be announced in a circular to be issued about November 1.

Dulau and Co. of London, have issued an album of half tone portraits of the Collaborators of the Scientific Reports of the Challenger Expedition arranged on nineteen plates. The edition is limited to 200 copies and is sold at 12s. 6d.

The Geological Survey of India, is engaged in investigating the recent earthquake near Calcutta in the most thorough manner, every available assistant being detailed to study some aspect or some locality.

The Vienna Academy of Sciences recently celebrated the fiftieth anniversary of its foundation. The government grant to the Academy has been increased from $16,000 to $20,000 yearly.

Mr. Alexander White has received the silver medal of the Zoological Society of London in recognition of his zeal in making large botanical and zoological collections in Nyassaland.

Professor A. P. Karpinski has resigned from the chair of geology in the Mining Institute at St. Petersburg and Dr. Ivan V. Muschketoff has been elected his successor.

The Woodwardian Museum of Cambridge, England, has received the geological library of Prof. Thomas Wiltshire. It contains about 600 volumes and 900 pamphlets.

Prof. Raphael Blanchard, of Paris, will begin the publication of a new journal the Archives de Parasitologie, the first number of which will appear in January.

The meeting of the German Zoological Society next spring will be held at Heidelberg. There was a total attendance of 50 at the meeting at Kiel this year.

The Deutsche Botanische Gesellschaft met this year at Brunswick, September 21 as a section of the Versammlung Deutscher Naturforscher und Arzte.

The Hopkins Marine Biological Laboratory at Monterey, California, is the subject of an article by Dr. Bashford Dean in *Natural Science* for July.

Dr. Zwaardemaker of Utrecht, has received the Tilanus gold medal from the University of Amsterdam for his work on the physiology of smell.

In the Imperial College of Science at Tokyo, there are 89 students. Of these 12 are taking Botany and Zoology and 14 are taking Geology.

Professor Virchow has been elected a foreign associate of the Paris Academy of Scienes in the place of the late Dr. Tchebitchef.

The German Anatomical Society will meet next year in April at Kiel. At its meeting in Ghent this year fifty were present.

Professor Wilhelm His has received the degree of Doctor of Philosophy, *honorio causa,* from the University of Leipzig.

The Prussian government will assist the fresh-water biological station at Plön after October, 1898.

The Zoological Gardens of Amsterdam, are described in *Macmillan's Magazine* for July.

Prof. R. Leuckart has been made a knight of the Prussian Order of Merit.

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CEPHALIC HOMOLOGIES. A CONTRIBUTION TO THE DETERMINATION OF THE ANCESTRY OF VERTEBRATES.[1]

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1. THE AFFINITIES OF AMPHIOXUS.

That Amphioxus has affinities both with Tunicates and with Vertebrates is, with our present knowledge, quite clear; but the relative degree of affinity on the two sides has not been settled. Amphioxus was originally classed with the fishes, but is now universally separated from them. Perhaps the most usual opinion is, that which classes Amphioxus with the Vertebrata, and divides the Vertebrata into two groups:—

I. CEPHALOCHORDA, (*Amphioxus*).
II. VERTEBRATA PROPER, (*Craniota*).

This division recognizes the fact that Amphioxus differs fundamentally from all the true vertebrates, but holds that the concept "Vertebrata" must be greatly extended and essentially modified, so as to admit the lancelet. The first writer known to me to deny that the Branchiostoma could be classed as a vertebrate was Carl Semper in 1875. This position has hitherto found little favor. Nevertheless, I hold that Amphioxus is more closely related to the Tunicates than to the Vertebrates, and that we ought to establish a group, which might be named Atriozoa, and would comprise Amphioxus and Tunicata.

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[1] Read before the British Association for the Advancement of Science, at Toronto, Canada, August 20, 1897.

The systematic value of embryology has been hitherto little recognized, but it certainly is of the greatest significance. It is not true that embryos are alike; on the contrary they show class, ordinal and generic differences from one another. I think, therefore, great stress must be laid upon the very close similarity in the embryonic development of Amphioxus and Tunicates. The fact of this similarity is now so familiar that it is superfluous to dwell upon it. On the other hand, it is desirable to renew attention to the large factor, which interpretation becomes, as soon as we attempt to establish a similarity between the ontogeny of Amphioxus and of the Vertebrates.

As regards the adult organization. The entire absence of lateral eyes and of lateral ears sharply separates both Tunicates and Amphioxus from the Vertebrata, while in the sense organs, they do possess, namely, the pigment spot or so-called eye, and the so-called olfactory pit, they are closely similar to one another, and quite unlike vertebrates. The attempt to identify the eye of Amphioxus with the pineal eye rests upon sheer speculation, and assumes that an organ developed in front of the neuropore is identical with one developed behind it. As regards the "olfactory pit," Kupffer's attempt to demonstrate a lobus olfactorius impar in Vertebrates is obviously unsuccessful. The atrium is another feature common to the Atriozoa, and is so highly distinctive, that it affords, what seems to me, an appropriate name for the whole group. The differences in the development of the atrium in the two classes of the Atriozoa are not, it is generally believed, such as to upset the homology, which is commonly maintained. The pharynx with its endostyle and ciliated bands, shows almost identity in Tunicates and Amphioxus, but only remoter resemblance to the Vertebrate pharynx, even to that of Ammocoetes with its hypobranchial groove. The gill clefts of

Amphioxus, both by their large number and by their peculiar subdivision, by secondary bars, resemble strikingly Tunicate gill clefts, but differ strikingly from those in any of the true vertebrates. How far the sexual organs of the cephalochorda and urochorda are comparable is not yet clear, but they show this striking resemblance that, in both, the sexual elements are discharged by dehiscence and pass through the ectoderm into the atrium, whereas in all vertebrates the sexual elements are discharged into the body cavity, or a duct derived from the body cavity. The excretory organs of Amphioxus in their association with the gills, and in their exterior or ectodermal openings show features which cannot be considered vertebrate, but I venture to express the expectation that homologous organs will be found in Tunicates. Finally as regards the central nervous system, the resemblance, which is almost identity, between Tunicates and Amphioxus has been often emphasized, but if we follow Howard Ayers in his attempt to homologize the parts of the brain in Amphioxus with those in true Vertebrates, we shall become only more and more impressed with the wide divergence between the two.

There remains the muscular system, which presents a striking and genuine resemblance to the metameric musculature of fishes, despite the secondarily acquired asymmetry in Amphioxus. It is a singular coincidence that some of those, who consider the segmentation of the body morphologically so insignificant, that it has no value to prove the kinships of Annelins and Amphioxus, yet consider it of great importance as evidence of the relationship of Amphioxus to the Vertebrates. But if we consider Amphioxus as a type intermediate between Annelids and Tunicates, the segmented musculature has been lost in the latter, an hypothesis which seems to me plausible, for as I have pointed out in my essay on " Senescence and Rejuvenation," all evolution of animals depends not only on the acquisition of characteristics, but also very largely on the loss of characteristics ; this loss, as exemplified in the gill clefts and arches of the higher Vertebrates, affects the early embryonic stages, apparently to allow the embryonic material to undergo a new development. The assumption that the Tunicates have lost segments offers fewer difficulties than the assumption that they acquired segments to develop into the vertebrate type.

If morphological evidence has any value whatever, the conclusion seems to me inevitable that the Tunicates and Amphioxus constitute a natural group, Atriozoa, which are somewhat distantly allied to the Vertebrata.

2. THE CHORDATA.

Zoologists are generally agreed that the Chordata is a natural group, in the sense that the Tunicates, Amphioxus and Vertebrates are more closely allied to one another than with any other known animals. I can find no reason for dissent from this view, it therefore suffices to follow those who have insisted that the problem of the origin of Vertebrates is part of the problem of the origin of Tunicates.

3. THE PRINCIPAL THEORIES OF THE ORIGIN OF VERTEBRATES.

It is, in my judgment, unnecessary to discuss the theories of Adam Sedgwick as to the origin of metameric segmentation,[2] or of Hubrecht that the Nemertines are the ancestral type from which Vertebrates have sprung. The latter I have discussed previously. Of the former I will only remark in passing that it seems strange that Sedgwick has persistently denied the concrescence theory of the embryo, and yet puts it forward as a new idea upon which he founds his hypothesis of metamerism.

There are five theories known to me which certainly require consideration, namely, Gaskell's, Patten's, Bateson's, and the Appendicularia and Annelid theories.

A. *Gaskell's theory* was ably presented in Dr. Gaskell's address, delivered last year at Liverpool before the Sections of Physiology and Zoology. The main points in this theory are that the Vertebrata arose from Crustacea like animals, the intestine of the latter becoming the tubular nervous system of the former, while a pharynx arose by the concresence of branchiate crustacean legs, the spaces between the legs becoming gill clefts. There are two fatal objections to this theory. I consider it a first and sufficient objection that it sets aside the evidence that the primary germ layers, ectoderm and entoderm are homologous throughout the metazoa. The evidence on this point is overwhelming. Gaskell's theory leaves a heart between the pharynx and the nervous system, so that to save his theory he has to make two supplementary hypotheses, first, that the crustacean heart disappears, and second, that a new or vertebrate heart is formed by the tips of the legs where they grow together. It is, indeed, difficult to give morphological credence to these two hypotheses. If Gaskell's hypotheses were true, we should expect to see some trace in the ontogeny of Vertebrates of the development of the pharynx by the concrescence of solid outgrowths, but, as well known, the pharynx is a series of hollow entodermal evaginations. As regards the neuron, Gaskell supposes that the ependyma represents the epithelium of the crustacean intestine, while the nervous matter represents that which collects in the walls of the crustacean intestine. This view, which is essential to his hypothesis, overlooks the fact that in Vertebrates the same epithelium produces both ependyma and nerve cells. Very numerous other objections can be raised, and consequently I am ready to go so far as to maintain that the acceptance of Gaskell's theory is impossible.

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[2] Of course, not because the theory does not need consideration, but because it deals not directly with the origin of Vertebrates, but with the origin of segmented animals.

B. *Patten's theory* seeks in the Arachnid type the ancestral form of Vertebrates. Under Arachnids Patten includes the Arachnida *sensu strictu,* and the Trilobites and Limulus also. It is noteworthy that the original articles by Patten and Gaskell appeared in the same number of the *Quarterly Journal of Microscopical Science,* (August, 1890). I have often wondered whether the juxtaposition was due to editorial design. Patten rests his case chiefly upon comparison of the nervous system, and makes only somewhat uncertain and tentative suggestions, as to the three serious difficulties offered by vertebrate characteristics, namely, 1, the disappearance of the invertebrate and origin of the vertebrate mouth; 2, the origin of the pharynx; 3, the origin of the notochord. Under these circumstances it is inevitable that the whole hypothesis seems highly tentative. Patten emphasizes the fact that the brain and oesophageal commissures of Arachnids form an angle with the ventral nerve chain, and he compares this with the head bend of Vertebrates, and seeks to homologize the supraoesophageal and suboesophageal nerves with these of Vertebrates. After a careful study it seems to me that he fails to render these comparisons morphologically justifiable. This failure does away with the only important argument offered by Patten.

C. *Bateson's theory* that Balanoglossus represents an ancestral type of the Chordata has attracted considerable attention, and Wiley apparently considers the theory proven. Bateson seeks to demonstrate a close homology between Balanoglossus and Amphioxus. Yet according to his own observations the structure of Balanoglossus is extremely different in every organ and in every part of every organ from what is found in Amphioxus, except as regards the pharynx, where there occur striking resemblances in the disposition of the gill bars. But Spengel has demonstrated that these are resemblances only, and that the arrangement of the bars in Balanoglossus is so fundamentally different from that in Amphioxus that it is out of the question to deduce one from the other. Again, according to Bateson's observations on the development of Balanoglossus, Tornaria is one of the forms least like the embryonic lancelet, for it entirely lacks the segmented mesoderm, the notochord and elongated medullary plate. Bateson, in my opinion, has drawn exactly the reverse of the conclusions as to the phylogenetic value of Balanoglossus, which are warranted by his own published observations. Spengel's criticisms of Bateson's theory are so conclusive, that it is superfluous to go over the ground again. But two points may be briefly mentioned, if only to escape the charge of trifling with the theory. Bateson lays much emphasis upon a structure, which he names the notochord of Balanoglossus; this so-called "notochord" is a short diverticulum of the cephalad end of the alimentary canal, running into the proboscis; this diverticulum remains hollow throughout life; whether it is of entodermal origin or not is unknown; Spengel considers it probably ectodermal. A notochord is a band of entodermal cells differentiated along the dorsal median line and ending originally at the blastopore, with the walls of which it is fused, and it lengthens by additions at its blastoporic end; it is never hollow and never a canal. These characteristics of a notochord are invariable, but not a single one of them pertains to the alleged notochord of Balanoglossus. The question arises, if two organs are found to have no resemblance to one another, is their homology demonstrated? Surely, a morphologist can give but one answer. My second point touches upon Bateson's views concerning metamerism. These views are based on the tacit assumption that serial repetition of organs or parts, even if irregular, is the same as segmentation of the body. But embryology had demonstrated, before Bateson's time, the true morphological basis of metamerism in segmented animals. This basis is the division of the mesothelium, as above stated, into paired symmetrical blocks. That this is the case is not an opinion, it is merely the summary statement of thousands upon thousands of direct observations. Serial repetitions, therefore, of ectodermal or entodermal organs, without these mesothelial segments, are morphologically not segmentation. Bateson's assumption that there is, what we may name a "*miscellaneous metamerism*," which, beginning in various parts, may lead on to true mesothelial metamerism is contrary to all morphological canons. That he considers this assumption necessary is another indication of the inherent weakness of his case.

So far as knowledge and discussion have brought us to-day, morphology has the choice between the two theories as to the origin of Vertebrates, the Appendicularia and the Annelid theory. A decision between these two alternatives, which shall be convincing to zoologists, is not at present possible, yet something, I think, may be determined as to the probabilities of the final choice.

D. The *Appendicularia theory* is the direct outcome of Kowalewski's embryological researches, and has been the subject of general attention from zoologists for a quarter of a century past. The full and able defense of it by W. K. Brooks in his Salpa monograph is so recent and well-known that it will suffice to recall that the theory assumes that Appendicularia is near the ancestral pelagic type of the Chordata; that it gave rise to a form with multiple gill openings leading to Tunicates, and by the further acquisition of segmental structure leading to Amphioxus, and from this last on to the true Vertebrata. It must be carefully noted that by the Appendicularia theory the prime morphological importance and significance is attributed to the notochord and the branchial pharynx, and a secondary importance to the metamerism, while the Annelid theory reverses this and attributes prime importance to the metamerism, and secondary to the notochard and pharynx.

E. The *Annelid theory* was founded independently by Dohrn and Semper, and has always been supported in my opinion by far more numerous and sounder arguments than any other theory of Vertebrate descent, with possibly the exception of the Appendicularia theory. The fullest presentation known to me, of the Annelid theory, is that by Hugo Eisig in his monograph of the Capitellidæ. Those, who have had theories of their own to defend, have never attempted (ought we not say, have never dared tc attempt?) to confute the Annelid theory. Sedgwick, Bateson, Willey, Gaskell, Patten, Morgan and others have either left the subject alone, or at most, have spoken slurringly and in disparagement of it, so that there are literally no important direct criticisms against the theory known to me. I take this to signify that the writers in questiod have attacked the problem of the ancestry of Vertebrates not in a judicial but in a somewhat partisan spirit.

4. APPENDICULARIÆ VS. ANNELIDA AS THE ANCESTORS OF THE CHORDATA.

The most essential difference between the two theories under consideration is formulated above in the paragraph on the Appendicularia theory. The alternative of choice between the two theories hinges upon the interpretation of Amphioxus which we accept, i. e.:

1. Is Amphioxus a Tunicate becoming a Vertebrate by the acquisition of segments?

2. Is Amphioxus an Annelid becoming a Tunicate by the acquisition of a notochord and gill bearing pharynx?

Of course, we all understand that Amphioxus is probably not the exact transitional form, but merely the nearest living ally, known to us, of the transitional form.

5. FURTHER AFFINITIES OF AMPHIOXUS.

We have already maintained that the nearest affinities of Amphioxus are with the Tunicates. We now are confronted by the question: Are its affinities on the other side closer with A, the Vertebrates, or B, the Annelids? Here I believe we we must start with the decision to leave the pharynx and notochord out of consideration, because these structures are characteristic of the Chordata as a whole and not of the Vertebrata. But there are three sets of organs in Amphioxus which offer special peculiarities morphologically; these are the segments, the sexual organs and the excretory organs. Let us consider these in order.

1. *Segments.*—The mesothelial segments of Amphioxus arise with their cavities in open communication with the archenteron. Ray Lankester has advanced, and O. Hertwig and others have adopted, the hypothesis that the coelom of Vertebrates is an enterocoele, but hitherto, although special investigations have been made, no conclusive evidence has been found that in any true Vertebrate there is a clear resemblance in the early condition of the mesoderm to the disposition characteristic of Amphioxus. Traces of evagination of the mesoderm along the edge of the notochord, as required by the enterocoele theory, have been described in various Vertebrate embryos by a number of authors. These traces are so slight and so variable, that I believe they would be considered as meaningless variations in the grouping of cells, similar to those occurring in other parts of the same embryos, were investigators not unduly influenced by the preconceived theory. No investigator has claimed, so far as I am aware, that any Vertebrate exhibits segmentally arranged mesoder-

mic diverticula. In other words, even if Lankester's enterocoele hypothesis holds true of the Vertebrates, they would still show only a very remote resemblance with Amphioxus so far as the early stages of the mesoderm are concerned. But there is yet another important difference between Amphioxus and the Vertebrates, namely, in the former the segments are total, in the latter partial. In Amphioxus the whole of the mesothelium is segmented, in Vertebrates only the dorsal regions of the mesothelium are segmented, the ventral regions or walls of the splanchnocoele are not segmented. That there is an impressive similarity between the formation of the mesodermic bands in Amphioxus and Annelids was shown by the discoveries of Hatschek, and in both types the segments are total. It is perfectly clear, therefore, that the early history of the mesoderm indicates a much closer affinity of Amphioxus with the Annelids than with the Vertebrates. The existing differences may be explained by the assumption that the cavities of the segments are formed in Annelids after, in Amphioxus during, the morphological separation of the mesoderm from the entoderm.

2. *Sexual organs.*—The sexual organs of Amphioxus are confined to the branchial region, they are segmentally arranged and they are lateral of the excretory organs. Those of Vertebrates do not appear in the branchial region, they are not segmented and are mediad of the excretory organs. The view that the sexual organs are developed from segmental anlages has been advanced, and such anlages have been named gonotomes. I have shown elsewhere, that this view is based upon an incomplete consideration of the facts, and recently C. Rabl has fully confirmed my arguments. In Annelids the sexual organs are segmented, and are so disposed that we can understand how, from an Annelid ancestor, they may have given rise to the disposition found in Amphioxus, but, unfortunately, no careful study of such possible comparisons is known to me. Evidently a direct comparison of the sexual organs of Amphioxus with those of Vertebrates involve the most serious difficulties, while the comparison with Annelids promises well.

3. *Excretory organs.*—Boveri has shown that the excretory organs of Amphioxus are tubules which begin with a ciliated internal funnel and open through the ectoderm, and that their primitive arrangement is probably segmental; they are confined to the branchiate region. They differ, therefore, from the segmental organs of Vertebrates, which open into a longitudinal internal duct, and occur only behind the branchiate region. It is true that the attempt has been made to show that the duct is originally derived from the ectoderm, but the weight of evidence—see especially Price on Bdellostoma, and Rabl on Elasmobranchs—is at present against this view and in favor of the mesothelial origin of the duct. In Annelids segmental organs have the same arrangement as in Amphioxus, they open directly through the ectoderm, and they also may occur in that part of the body which, on the theory of Annelid ancestry, must have been evolved into the pharynx. The morphology of the excretory organs is thus readily perceived to indicate the Annelidian rather than the Vertebrate relationships of Amphioxus.

And now I ask, must we not conclude that Amphioxus is a Chordate nearly related to Tunicates, more remotely related to Vertebrates, and revealing in its organization important differences from other Chordata, which differences demonstrate a true kinship with Annelids? Now certainly no one would venture to regard Amphioxus as the ancestor of the Annelida, hence we are obliged to consider the Annelida as representing the ancestral type of the Cephalochorda, and, therefore, of all Chordata.

b. *The position of Appendicularia.*—The conclusion just stated involves the assumption, so far as now appears, that Appendicularia is not an ancestral but a secondary type. But Appendicularia much resembles a young stage of other Tunicates (free swimming larvæ), and we have learned to trust so much to the law of recapitulation (Haeckel's Biogenetisches Grundgesetz) that it is hard to believe that it does not govern Appendicularia, which would then be of the phylogenetic significance assumed by W. K. Brooks, whose argumentation is so strong, that even while defending the Dohrn-Semper theory, one must have in reserve readiness to change sides.

7. ORIGIN OF VERTEBRATA.

If the Annelids gave rise to the Chordata, we must consider the possible origin of certain anatomical characteristics of the Vertebrates, *sensu strictu.* Of such characteristics three are specially prominent, the general arrangement of the mesoderm, the pronephric duct, and the head with its arrangement of mouth, brain and eyes so unlike that in Annelids.

1. *The mesoderm* of Vertebrates, as already remarked, is characterized by having a large splanchnocoele and by being segmented only in its dorsal or epiaxial part. In Amphioxus the mesoderm is at first totally segmented as in Annelids, and later develops a splanchnocoele, and assumes in other respects an arrangement (of sclerotome and cutis plate) wonderfully comparable, according to Hatschek, with the vertebrate type of mesoderm. Amphioxus seems to really afford the key for the transition of the mesoderm from the Annelid to the Vertebrate type, and the occurrence of the actual transition ontogenetically renders it natural to advance the theory of the corresponding transition phylogenetically, thus obviating one of the former difficulties in the Annelidan theory of the origin of Vertebrates.

2. *The pronephric duct,* (often referred to as the Wolffian duct). This is a longitudinal epithelial tube, into which the segmental organs of Vertebrates open. Hatschek, in his paper on Polygordius, suggested that the segmental organs might acquire a direct secondary connection with one another; a series of such connections would make a longitudinal duct. Edward Meyer found such connections in adult Annelids, and other instances are known, see Willey's Amphioxus, 80–82. Price's observations on the Californian Myxinoid, and Rabl's on Elasmobranchs, tend to show that this is the actual origin of the duct. We no longer, therefore, need to take refuge in Haddon's or Boveri's hypothesis of the origin of the duct, since Hatschek's theory is sufficient and is supported by such actual evidence as we possess.

3. *Cephalic homologies.*—Up to this point we have dealt with knowledge and ideas derived from previous scientific publica-

tions, and have done little more than attempt to present the problem critically. As regards the head, however, even theories have hitherto failed us, and no hypothesis as to the evolution of the vertebrate head from the Annelidan type has been brought forward, which çould not be shown to encounter insuperable objections, or at least which appeared insuperable to those who were opposed to the Annelidan theory. The suggestion most widely known and discussed is that the invertebrate mouth disappeared, the oesophageal ring with the neighboring ganglia formed the vertebrate brain, and a new vertebrate mouth was evolved, according to Dohrn, by the fusion of two gill clefts in the ventral median line.

I ask your consideration for an entirely different theory of the homologies of the vertebrate head. A morphologist must feel grave hesitation in assuming that such important structures as the main lateral eyes and as the oral evagination should have totally disappeared during the evolution of Vertebrates, for they are an advancing type, not a degenerate type losing its organs. He must also feel grave hesitation in assuming that main lateral eyes have been evolved in the Articulates and Vertebrates without any genetic relationship. It is natural, therefore, to test the assumption that the articulate eyes and vertebrate eyes are phylogenetically homolgous, it being, of course, understood that the comparison excludes ocelli, accessory eyes in Annelids and the pineal eye of Vertebrates. We note at once that the visual sensory apparatus in both cases is epithelial in type, and is derived immediately from the ectoderm, and further that in both cases the sensory apparatus is directly connected with nervous substance, in Articulates the so-called optic ganglion, in Vertebrates the nervous tissue of the retina, and finally that in both cases there runs from the optic apparatus a fibre tract, which is not a nerve, but a commissure, that is to say, a differentiation of a part of the central nervous system itself; this tract we call a part of the oesophageal commissure of the Articulate, and the optic nerve of the Vertebrate. We are thus lead to the supposition that eyes and optic nerves represent in Vertebrates the main eyes, the supra-oesophageal ganglia, and the oseophageal commissures of the Articulates. Can this supposition be upheld? I do not think that the invagination of the optic vesicles in Vertebrates will be said by any morphologist to invalidate the comparison. At first it seems to reduce the so-called "brain" of Articulates to insignificance, but as we know that this brain, or more correctly, supra-oesophageal ganglion, is mainly a visual ganglion in Articulates, and it is by no means a great degradation for it to appear merely as a retina in Vertebrates. We must not be influenced by the misuse of the word "brain" applied to Invertebrates. But how can two diverging vertebrate eyes, which form a Y with the main nervous system, be the same as a complete nervous ring around the oesophagus? This difficulty is met by assuming that the eyes and optic ganglia fail to meet in the median line in front. In connection with this assumption, remarks upon two points are necessary. *First*, in Invertebrates with oesophageal nerve rings, the supra-oesophageal ganglia do not apparently arise in the median line, but as two symmetrical anlages, which subsequently meet in the median line. I recall that this is the method of development in Lumbricus (E. B. Wilson), Arachnids and Insects (Patten), Crustacea (Kingsley), and in Crepidula (Conklin). Other observations could be cited.[3] Hence we have only to believe that in the Vertebrates the separation is maintained and increased. *Second*, there should be found a cause for the separation of the eyes (supra-oesophageal ganglia) in the Vertebrates. This is given by the growth of the vertebrate brain, which is enormous and precocious. If the brain acquires great size, the eyes are correspondingly separated. It is evident that our assumption makes the brain homologous with the suboseophageal ganglia probably plus several ganglia of the ventral chain, the remainder of the ventral chain becoming homologous with the spinal cord.

Next as to the invertebrate mouth. If the eyes and optic nerves represent the oral nerve ring, we must look for the invertebrate mouth between the eyes. The invertebrate mouth is an ectodermal invagination, which has a direct or acquired open communication with the entodermal cavity or archenteron. Is there such an evagination in the Vertebrates? Unquestionably there is, and a large conspicuous and well known one, which gives rise to the olfactory pits and to the hypophysis proper. It is important to recall that the naso-hypophysal invagination is single, and we may homologize it with the Annelid ectodermal stomodaeum. It seems to me a very significant fact that in the lowest Vertebrates (the Myxinoids) the naso-hypophysal invagination opens through the entoderm into the pharynx. This connection, which has been known but the significance of which has remained obscure for three-quarters of a century, may, under the supposition we are considering, be interpreted as the survival of the Annelidan condition. In other Vertebrates (Petromyzon and Gnathostomes) the opening mentioned does not recur, although contact between the ectoderm of the invagination and the pharyngeal entoderm can, it is claimed, be observed in certain forms (Accipenser, etc). To avoid confusion, it must be pointed out that the hypophysis is only a part of the invagination, and neither it nor the general invagination are connected with the neuropore; the hypophysis of Vertebrates is, therefore, not homologous with the neuroporic pit, which Willey and others have erroneously named the hypophysis of Amphioxus and Tunicates.

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[3] That the observations are conflicting as to the paired origin of the Articulate brain is well known, but the theory that the median Scheitelplatte evolved into the Articulate brain encounters difficulties which seem to me very serious.

What is the actual vertebrate mouth? If we interpret the naso-hypophysal invagination as the homologue of the Annelidan mouth-gut, we find that the oral invagination is sepated from the hypophysal by a fold, which becomes the upper jaw in Cyclostomes, and which is present in the embryos of all Vertebrates. (In Anmiote embryos this fold forms a ridge between Seesel's pocket and the hyphophysis). It, therefore, still remains necessary to look upon the vertebrate mouth as a new acquisition. It seems to me that, under the new conception of the head, Dohrn's hypothesis is more promising than before. But beyond this I can add nothing to the explanations of the vertebrate mouth previously attempted.

The brain arose, by the present supposition, from the ganglia of the "ventral" chain of Annelids. Even in Articulata, in the Crustacea and Arachnida, we encounter a tendency of the thoracic ganglia to make a brain. If the brain did thus arise, its enlargement would cause, as we see in the Vertebrate embryo, the brain to expand forwards, and since there is no corresponding growth on the hæmal side, this expansion would cause the projecting head to bend over towards the hæmal (Annelid dorsal, or Vertebrate ventral) side, and thus carry the mouth into a new position, and at the same time prevent the eyes and praeoral ganglia from meeting in the median line and force the visual organs into lateral positions. We thus reach a natural and simple explanation of the difference between the Annelid and Vertebrate head. The conception brought forward is favored by the conditions observed in Myxine and Petromyzon, for the eyes in these forms are small, in Myxine without a lens. The large size of the eyes is a subsequent acquisition of the Gnathostomes. By my hypothesis we should expect the evolution of the brain to precede that of the eye in Vertebrates. Finally, the vertebrate brain, by our supposition, was segmented originally throughout, and that this idea is correct is indicated by the trend of recent opinions formed by investigators of the cephalic neuromeres, and the morphology of the cephalic nerves in the Vertebrata.

The series of considerations outlined justify the hypothesis presented, namely, the Vertebrate head was evolved from the Annelid head. The three principal factors in this evolution were: 1. The formation of the vertebrate brain from several of the post-oral ganglia of the ventral chain. 2. The preservation of the ectodermal mouth-gut (Vorderdarm) of Annelids as the naso-hypophysal invagination. 3. The conversion of the visual apparatus and supra-oesophageal ganglia, which are prevented from fusing in the median line by the enlargement of the vertebrate brain, into the vertebrate eyes (retina), the oesophageal commissures persisting as optic nerves.

If this hypothesis be ultimately verified and shown to be in full accordance with the facts, it will obviate those difficulties of the Dohrn-Semper Annelid theory of the origin of Vertebrates, which at present are the most serious.

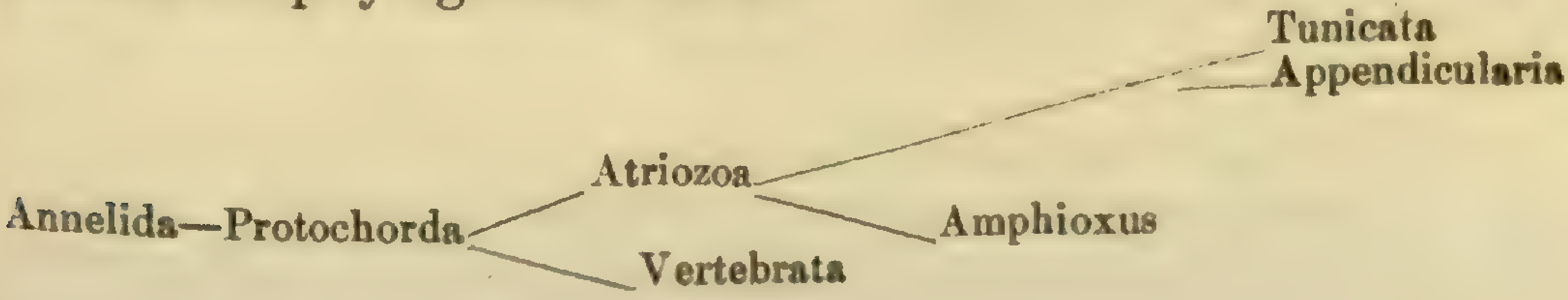
One more point, the cephalic homologies advocated increase the morphological importance of the eyes, and further emphasize the divergence between Amphioxus and Vertebrates, and makes the absence of lateral eyes in Amphioxus more significant even than before, and affords a further justification for the union of Amphioxus with the Tunicata.

I have presented the subject in the merest outline, for almost every sentence might be expanded to a paragraph, often into a chapter, without making the treatment exhaustive, but I hope enough has been said to make the argumentation clear and to justify it.

The origin of Vertebrates is one of the most difficult and obscure problems which at present occupy the general attention of zoologists. I am well aware that my own studies have concentrated upon the embryology of Vertebrates, and that it is difficult, perhaps, impossible, for one man to have a first hand mastery through his own observations of all the evidence which must decide the final solution. I have expressed, therefore, not convictions, but probabilities, and must certainly reserve the right to adopt other conclusions than those above advocated. The rival theories have sometimes taken on a very positive tone, and their advocates have referred to the Dohrn-Semper theory as a thing of the past, discarded and quite disproved. This attitude is regrettable, and I hope, by showing that much can still be said in favor of the origin of Vertebrates from Annelids, to contribute towards a sober and judicial discussion of an important and interesting topic.

8. CONCLUSION.

It remains only to present the following simple and comprehensive phylogenetic table :—



THE LIMITS OF ORGANIC SELECTION.

BY HENRY FAIRFIELD OSBORN,

OPENING A DISCUSSION BEFORE THE SECTIONS OF GEOLOGY AND BOTANY AT DETROIT.

The object of this paper is to set forth certain views as to the limits of the supplementary natural selection hypothesis recently proposed by Prof. James Mark Baldwin, Prof. C. Lloyd Morgan and myself as "Organic Selection."

The line of thought which led me to Organic Selection was as follows: The distinction between the *ontogenic* and *phylogenic variation* was drawn in my mind in 1894,[1] because it was evident in the current researches upon variation by Weldon, Bateson and others, and in the line of reasoning followed by Cope, Ryder, Scott, Osborn and other Neo-Lamarckians that the importance of such a distinction was being overlooked. There are three main types of variation: First, *fortuitous congenital* variations which are the temporary and transitory fluctuations around a mean. Second, *ontogenic variations*[2] which are the departures from normal or typical development arising during *ontogeny*; they include all the effects of the reaction of the individual to new or disturbed conditions of life which rise in the course of individual growth and may disappear with the death of the individual; the mooted question whether ontogenic variations are or are not heritable does not affect their distinctness. Third, *phylogenic variations*, also congenital, which belong in the phylum, as observed principally in fossil series; they are stable and inheritable departures from ancestral types towards a new type; they correspond with the "mutations" of Wagner and Scott, i. e., they are departures from ancestral types which have become permanently established. They constitute the main *evidence* for determinate variation and as a consequence determinate evolution.

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[1] Alte und Neue Probleme der Phylogenese. Ergeb. d. Anat. u. Entwick., Merkel u. Bonnet, III Band, 1893, pp. 584–625.

[2] Prof. C. Lloyd Morgan has proposed to apply the word "*modification*," variously used by Cope, Bailey and other authors, to what is above described as "*ontogenic variation*" and to restrict the term "*variation*" to congenital variation. This excellent suggestion subserves clearness, and should be adopted by all writers.

In every analysis of variation these distinctions are of profound importance, because every adult organ we study (whether with Weldon it is the frontal measurement of a crab or, with Cope and Tornier, the articular facet of a bone), may be an exponent either of constitutional, phylogenic, or stirp factors, or of new environmental and ontogenic factors, or of the fortuitous or chance elements in development, or finally of all three factors combined.

In March, 1896, the application of this distinction to the problem of the *causes* of "determinate variation" was pointed out by myself in course of a discussion in the New York Academy of Sciences (p. 141) as follows: "For example, if the human infant were brought up in the branches of a tree as an arboreal type instead of as a terrestrial, bi-pedal type, there is little doubt that some of the well known early adaptations to arboreal habit (such as the turning in of the soles of the feet, and the grasping of the hands) might be retained and cultivated; thus a profoundly different type of man would be produced. Similar changes in the action of environment are constantly in progress in nature, since there is no doubt that the changes of environment and the habits which it so brings about far outstrip all changes in constitution. During the enormously long period of time in which habits induce ontogenic variations, it is possible for natural selection to work very slowly and gradually upon predispositions to useful correlated variations, and thus what are primarily *ontogenic variations* become slowly apparent as *phylogenic variations* or congenital characters of the race. Man, for instance, has been upon the earth perhaps seventy thousand years; natural selection has been slowly operating upon certain of these predispositions, but has not yet eliminated those traces of the human arboreal habits, nor completely adapted the human frame to the upright position. This is as much an expression of habit and ontogenic variation as it is a constitutional character. This fact, which has not been sufficiently emphasized before, offers an explanation of the evidence advanced by Cope and other writers that change in the forms of the skeletons of the vertebrates first appears in ontogeny and subsequently at birth in phylogeny."[3]

On April 13, 1896, I formulated the matter in a paper before the Academy entitled "A Mode of Evolution Requiring neither Natural Selection nor the Inheritance of Acquired Characters," which has since appeared in *Science.* Professor Baldwin, of Princeton, and Professor Lloyd Morgan, of University College, Bristol, had at the same time, independently reached the same hypothesis, and Professor Baldwin has aptly termed it "Organic Selection." Both writers have presented valuable critical papers upon it, including in *Science* and *Nature* a complete terminology for the various processes involved. I concur entirely in their proposal to restrict the term *variation* to congenital variation, to substitute the term "*modification*" for ontogenic variation, and to adopt the term "*Organic Selection*" for the process by which individual adaptation leads and guides evolution, and the term "*orthoplasy*" for the definite and determinate results.

The hypothesis, as it appears to myself is, briefly, that *ontogenic adaptation is of a very profound character, it enables animals and plants to survive very critical changes in their environment. Thus all the individuals of a race are similarly modified over such long periods of time that, very gradually, congenital variations which happen to coincide with the ontogenic adaptive modifications are collected and become phylogenic. Thus there would result an apparent but not real transmission of acquired characters.*

It is a subsidiary question whether this hypothesis is new, and a more important one whether it is true and constitutes a distinct advance towards the discovery of the unknown factors of evolution, or a satisfactory substitute for the Lamarckian theory of transmission of acquired characters.

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[3] A writer in the *Fortnightly Review* has given a somewhat extreme illustration of the difference between ontogenic and phylogenic progress when he says: "Man is still, mentally, morally and physically, what he was during the later Palæolithic period." "The Artificial Factor in Man." Fortnightly Review, October, 1896.

It appears that the idea involved in Organic Selection is by no means a new one, it is formulated, for example, but not with especial stress or clearness by Weismann in his *Romanes Lecture* of 1894, as shown in the following selections from pages 11–17 (italics our own):[4]

"Hermann Meyer seems to have been the first to call attention to the adaptiveness as regards minute structure in animal tissues, which is most strikingly exhibited in the architecture of the spongy substance of the long bones in the higher vertebrates. . . . . But the direction, position and strength of these bony plates are by no means innate or determined in advance: they depend on circumstances. . . . . It is not the particular adaptive structure themselves that are transmitted, but only the quality of the material from which intra-selection forms these structures anew in every individual life. Peculiarities of biophors and cells are transmitted, and these may become more and more favorable and adaptive in the course of generations if they are subject to natural selection. . . . . *Intra-selection effects the special adaptation of the tissues to special conditions of development in each individual.* . . . . Let us take the well-known instance of the gradual increase in development of the deer's antlers, in consequence of which the head, in the course of generations, has become more and more heavily loaded. . . . . It is by no means necessary that all the parts concerned—skull, muscles and ligaments of the neck, cervical vertebræ, bones of the fore-limbs, etc.—should simultaneously adapt themselves by *variation of the germ* to the increase in the size of the antlers; *for in each separate individual the necessary adaptation will be temporarily accomplished by intra-selection—by the struggle of parts—under the trophic influence of functional stimulus.* . . . . But as the primary variations in the phyletic metamorphosis occurred little by little, the secondary adaptations would probably, as a rule, be able to keep pace with them. *Time would thus be gained till, in the course of generations, by constant selection of those germs the primary constituents of which are best suited to*

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[4] The Effect of External Influences upon Development. The Romanes Lecture, 1894. London, 1894.

one another, the greatest possible degree of harmony may be reached, and consequently a definite metamorphosis of the species involving all the parts of the individual may occur. . . . ."

What appears to be new therefore in Organic Selection is, first, the *emphasis* laid upon the almost unlimited powers of individual adaptation; second, the extension of such adaptation without any effect upon heredity for long periods of time; third, that *heredity slowly adapts itself to the needs of a race in a new environment along lines anticipated by individual adaptation, and therefore along definite and determinate lines.* This hypothesis, if it has no limitations, brings about a very unexpected harmony between the Lamarckian and ultra-Darwinian (Weismannian) aspects of evolution by mutual concessions. While it abandons the transmission of acquired characters, it places individual adaptation first and fortuitous variation second as Lamarckians have always contended, instead of placing survival conditioned by fortuitous variations first and foremost as Selectionists have contended. If true, it is thus a compromise between the pure Lamarckian and pure Darwinian standpoints in which the concessions are about equal. And if true it gives us at least a partial explanation of determinate variation which Lamarckians have recently contended for, and Darwinians have strenuously denied.[5]

Professor Alfred Wallace has recently endorsed this hypothesis in a review of Professor Morgan's work, "Habit and Instinct," in the March, 1897, number of *Natural Science* in the following language: "Modification of the individual by the environment, whether in the direction of structure or of habits, is universal and of considerable amount, and it is almost always, under the conditions, a beneficial modification. But every kind of beneficial modification is also being constantly effected through variation and natural selection, so that the beautifully perfect adaptations we see in nature are the result of a double process, being partly congenital, partly acquired.

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[5] See Osborn: Cartwright Lectures, Present Problems in Evolution and Heredity, 1891. Also, "Is Variation Definite or Indefinite?" American Naturalist, 1889.

Acquired modifications thus helps on congenital change by giving time for the necessary variations in many directions to be selected, and we have here another answer to the supposed difficulty as to the necessity of many coincident variations in order to bring about any effective advance of the organism. In one year favorable variations of one kind are selected and individual modifications in other directions enable them to be utilized; in Professor Lloyd Morgan's words: 'Modification *as such* is not inherited, but is the condition under which congenital variations are favored and given time to get a hold on the organism, and are thus enabled by degrees to reach the fully adaptive level.' The same result will be produced by Professor Weissman's recent suggestion of 'germinal selection,' so that *it now appears as if all the theoretical objections to the 'adequacy of natural selection' have been theoretically answered.*" (Italics our own.)

Alfred Wallace thus accepts this new phase of the natural selection theory and maintains that it removes the last of the theoretical objections to the adequacy of that theory. I do not wish to be understood as taking such a sanguine view; I rather maintain the conservative position which I have held for many years in regard to the adequacy of both the Lamarckian and Darwinian theories.

Moreover, in course of discussion of this subject with my friends Professors Lloyd Morgan, Baldwin and Poulton, a very fundamental difference of opinion becomes apparent; for they agree in believing that the power of plastic modification to new circumstances, or what the Rev. Dr. Henslow has termed "self-adaptation," is in itself a result of natural selection. In other words they hold that natural selection has established in organisms this power of invariable response to new conditions, which, in the vast majority of cases is essentially adaptive. I disagree with this assumption *in toto*, maintaining that this plastic modification is, *so far as we know* an inherent power or function of protoplasm. This view, I understand, is also held by Driesch, E. B. Wilson, T. H. Morgan and probably by many others. The only cases in which self-adaptation may be demonstrated as produced by natural selection are where organisms are restored to an environment which some of their ancestors experienced. We can then imagine that the adaptive response to the old environment is something which has never been lost as in the well known reappearance of the pigment in flounders.

It may be urged against the Morgan, Baldwin, Poulton views that the remarkable powers of self-adaptation, which, in many cases are favorable to the survival of the individual, are in many cases decidedly detrimental to the race, as where a maimed or mutilated embryo by regeneration reaches an adult or reproductive stage. It is obvious that reproduction from imperfect individuals would be decidedly detrimental, yet from the view taken by the above authors such reproduction would be necessary to secure the power of plastic modification for the race.

It is certain, that at the present time, one of the surest and most attractive fields of inductive research, leading towards the discovery of the additional factors of evolution or what I have elsewhere called "the unknown factor," is in experimental embryology and experimental zoology. If we could formulate the laws of self-adaptation or plastic modification we would be decidedly nearer the truth. It appears that Organic Selection is a real process, but it has not yet been demonstrated that the powers of self-adaptation which become hereditary are only accumulated by selection. They may possibly be accumulated by the inheritance of acquired modifications as Lamarck supposed.

Furthermore, another difficulty which I find with the completeness of the Organic Selection hypothesis is identical with that which almost from the outset made me hesitate in regard to the completeness of the Lamarckian hypothesis, namely, many structures, such as the teeth, which exhibit no power of self-adaptation or plastic modification during life, which are, in fact, rendered decidedly less effective instead of more effective by use and habit—these structures, I repeat, show precisely the same determinate and definite variation and consequent evolution as that which is exhibited in plastic and self-adaptive structures. This being the case, it is clear that " Organic Selection" leaves a very large field of determinate evolution entirely uncovered and unexplained, and there remains a *tertium quid* which requires further investigation. Determinate evolution in these non-plastic structures at present strikes me as part of the mechanical necessities of development, if I may so express it. That is, given a certain primitive form, there is only one route along which it can attain a certain end, provided the intervening stages are mechanically effective. It is some such law of mechanical necessity as this which out of the conical type of reptilian teeth has evolved first the triconodont type, the tritubercular, and finally the multitubercular, and from these main stages have arisen sub-stages which are repeated and independently acquired over and over again in different branches of the mammalian class. This is not an explanation, or a theory, it is a fact yet to be understood.

Organic Selection constitutes a distinct advance, and is, at least, a very useful working hypothesis, but it is by no means the conclusion of the whole matter, as Alfred Wallace maintains. We must persevere in our analysis of life processes as revealed in living organisms and in fossils with a perfectly open mind, perhaps for many decades, perhaps for another century, before we reach final conclusions in regard to the complex processes of evolution.

Columbia University.

THE GEOLOGICAL CONGRESS IN RUSSIA.

By Charles Palache.

The Seventh International Geological Congress assembled in St. Petersburg during the first week of September, 1897. The Congress was notable among the meetings of this organization for the large number in attendance. It will certainly be memorable, to such of its members as took part in them, for the extent and interest of the excursions planned in connection with it and for the warm-hearted hospitality tendered them in every part of the broad empire which they visited.

The program of excursions, issued early in the year by the Committee of Organization, was carried out in all its essential details. Moscow was the starting point of the first excursion to the Urals preliminary to the Congress, and consequently it was that city which most of the excursionists made their first objective point on entering the country. We found wherever we crossed the border that our membership tickets made the passage through the Custom House easy, although they did not replace our passports which we had often to show. Our railroad passes too, were accepted without question, and the most courteous treatment greeted us on every hand.

At Moscow we found the Bureau of the Congress established in the halls of the University, and here and in the parlors of the Continental Hotel, frequent gatherings of the excursionists took place during the three days we were in the city. The excursions in the vicinity of Moscow were of moderate interest geologically, the greatest attaching to that which visited the richly fossiliferous middle Carboniferous beds of Miatchkowo on the bank of the Moskwa River. On the other hand, the city itself with its wholly oriental character in architecture, coloring and street life, offered more than enough attractions to occupy the time at our disposal, and there were doubtless few who did not regret leaving this, the centre and fountainhead of the Russian national life.

About one hundred and thirty-five persons took part in the Ural excursion, of whom nine were ladies. A special train of thirteen cars was our means of transport and place of abode for the first three weeks of the trip, while a restaurant train of box cars, provided with tables and chairs, preceded us and furnished forth our meals. If there were numerous discomforts associated with this style of living, one could not but remember that there was no precedent for or experience of such an excursion as ours in the remote regions which we visited, and criticism was disarmed by the conditions.

From day to day excursions of various kinds were made along or away from the general line of the railroad which was our base of operations. A steamer trip from Samara, on the Volga—a walk along the railroad, fifteen miles from Acha to Miniar, giving a fine section of the Carboniferous and Devonain strata—a two day's wagon trip to the iron mines (limonite) of Bakal—a visit to the foundry at Simsk and its charming environs—such were a few of the earlier excursions which, besides showing interesting geological sections, gave us a good opportunity to become acquainted with the customs and mode of living of the people of the region. And at every mine and foundry, in many of the towns and even at the railway stations, we found the heartiest welcome awaiting us, great concourses of people who looked upon us with undisguised curiosity but evident good will, receptions by the local authorities, and numerous lunches and banquets of the most lavish description. It is difficult indeed, to express the feeling of growing wonder which all shared at the continuous ovation that greeted us on all sides as we made our progress through these mountainous regions, seemingly so little calculated to afford such entertainment as we found. Still, harsh as it may seem to criticise in such a case, it must be confessed that there was too large a share of our time devoted to social functions, and we might have seen many additional localities of geologic interest had we not been compelled by our kind hosts to arrange our movements in accordance with their too frequent hospitalities.

The guide book of the excursions was prepared in the form of separate pamphlets for various localities or regions, written by the men who were best acquainted in each and who were to be our leaders. The descriptions were generally good, though often lacking in details; the sections and illustrations were satisfactory, though the mine sections rarely corresponded with the visible exposures. The accompanying geological map of Russia, scale 1:6,300,000, reduced from the larger map published by the Geological Committee in 1892, scale 1:2,520,000 served as a very convenient means of orientation.

In the region between Moscow and Oufa where our leader was Nikitin, we saw horizontal or slightly disturbed strata ranging from Cretaceous downward to middle Carboniferous.

At Oufa, at the foot of the Ural Mountains, we entered a zone of openly folded paleozoic rocks including the Devonian series, the folds becoming rapidly more compressed and the disturbances greater as we advanced into the mountains. At Slatoust we encountered the first crystalline schists, considered by Tschernyscheff our leader, on stratigraphic evidence which but few of the party considered conclusive, to be metamorphic Devonian.

Within this band of schists or on its borders, is a group of mineral localities which have produced many interesting and beautiful specimens obtained by the efforts of many engineers of the Russian Mining Bureau through a long series of years, and now in large part preserved in the cabinet of the Mining Academy in St. Petersburg. These minerals all appear to be contact products between clay slates and limestones and massive eruptive rocks of the character of diorite or peridotite. One of the best known and most typical of these occurrences is the Achmatoff mine. Here, on a more or less chloritic matrix, were found beautiful crystallizations of garnet, epidote, pyroxene, vesuvianite, such titamium minerals as perofskite, titanite and ilmenite, zircon, apatite and various members of the chlorite group.

Passing eastward still across the Ural divide, we entered a region of gneisses and granitic rocks. The day spent at Miass, in the Ilmen Mountains, under the joint leadership of Karpinsky and Arzruni, was replete with interest. The Ilmen Mountains are a subordinate range of the Ural chain composed largely of eleolite-syenite, classical under Gustav Rose's name of *miascite.* This rock is well exposed, is rich in a variety of minerals and offers numerous interesting problems to the petrographer. The most notable minerals here collected, chiefly from the pegmatitic facies of the rock, were nepheline, cancrinite and sodalite, zircon, apatite, ilmenite and biotite in huge plates. In the pegmatite veins traversing the neighboring gneiss and granite, we saw a very different group of minerals including albite and microcline, topaz, zircon and euclase and samarskite, pyrochlor and other rare earth minerals.

At Miass, also, was the first of the gold placers which are worked, by what seemed crude and primitive methods, in various parts of the Urals.

At Tcheliabinsk, the eastern limit of our excursion, as well as at Beresof, near Ekaterinburg, we saw gold-bearing quartz veins, the former only recently explored, the latter with extensive workings dating back many years.

At Ekaterinburg, the principal city of the Ural region, we we were hospitably entertained by the Ural Society for Natural Science, and were shown an interesting exhibit of the products of numerous local establishments for the cutting of gems and semi-precious stones.

Continuing northward our next halt was in the busy mining town of Njni-Taghilsk. Within this district are the extensive iron mines (magnetite) of Wyssokaia and Blagodat; the copper mine of Mednoroudiansk, famous for its former production of the malachite so prized in Russian decoration; largely worked deposits of manganese ore, and the platinum placers at Platina. This last metal appears to occur in the peridotitic rocks which constitute the bed rock of the region; their decomposition sets it free, so that it may be won by placer washing.

Again crossing the water-shed of the Urals and descending rapidly to the plain we reached Perm on the Kama River, where we left our train for a roomy and comfortable steamer on which for three days we floated down the stream to its confluence with the Volga. Numerous excursions on the banks made us acquainted with the Permian series, including the upper, Permo-triassic division, the so-called " etage tartarien." Turning up the Volga we halted at the old tartar city of Kazan, where we were entertained by the university and later by the city. And the end of the fourth day from Perm found us at Njni-Novgorod. A day was spent here seeing the fair, and then we took train directly for St. Petersburg, where we found the quarters previously assigned us in the many hotels of the city or in the large dormitory of the university, where some fifty of the members were located. The hundred and twenty members of the Finland excursion reached St. Petersburg the same morning (August 28th) by steamer, reporting a most interesting week's trip, during which they had enjoyed quite as lavish hospitality as had been the lot of those in the Urals. They were under the guidance of Sederholm, and saw much glacial geology in addition to the old crystalline formations of western and southern Finland.

The formal opening of the Congress took place the afternoon of Sunday, August 29th, in the hall of the Zoological Institute of the University, which was well filled by a large and brilliant audience. The Honorary President of the Congress, the Grand Duke Constantine Constantinovitch, presided and opened the session with an address of welcome. It was followed by similar addresses by the Princess of Oldenburg, President of the Imperial Society of Mineralogy, and by the Minister of Agriculture, Ermoloff. Renevier, President of the preceding Congress, announced the officers named by the council, the American Vice-Presidents being Marsh, Emerson, Emmons and Frazer. The address of the President, Karpinsky, was chiefly occupied with a brief statement of the questions to come before the Congress, and after a resumé by Tschernyscheff, Secretary-General, of the work of the Committee of Organization in arranging for the Congress and excursions, the session came to a close.

Of the eight hundred and fifty names which appeared in the official list of the members of the Congress, upwards of six hundred were recorded as in attendance. Despite this very large membership the actual number at the meetings was very small, rarely more than one hundred being present. But the adjoining hall where numerous exhibits were arranged was always occupied by a throng of members, showing very clearly that here as generally in such meetings, it is the personal intercourse that is desired by the members rather than the formal discussions.

The subjects which it was desired to have specially brought before this Congress, as announced in an early circular of the Committee of Organization and as stated in the President's address, were as follows:

1. Shall stratigraphic nomenclature be based upon an artificial or upon a natural classification.

2. Establishment of rules governing introduction of new terms in stratigraphic nomenclature.

3. Adoption of definite principles of classification of rocks and of petrographic nomenclature.

The discussion of the first question showed clearly the opinion of most of the geologists present that the accepted artificial classification was the only admissable one, its abandonment for what must necessarily as yet be a somewhat vague and ill-defined substitute, being certain to result only in a state of confusion in the science.

Discussion of the second proposition centered upon papers presented at an early meeting by Frech, Breslau, Ueber Abgrenzung und Benennung der geologischen Schichtengruppen, and by Bittner, Vienna, Vorschläge für eine Normiring der Reglen der stratigraphischen Nomenclatur.

The propositions of these writers as modified and accepted by the Congress amounted to little more than a formal statement of the ordinary practice of geologists with regard to new names. They were in brief as follows:

1. Introduction of a new stratigraphic term into the international nomenclature, should be based only on a well determined and peremptory scientific necessity, should be accompanied by full description of deposits to which it is applied, and should be founded on facts observed on more than a single exposure.

2. A name applied to any deposit in a definite way is not to be used in another sense.

3. Date of publication determines priority of terms.

4. In giving new names to minuter stratigraphic subdivisions, it is desirable to take paleontological characteristics as a base. Geographic names should only be used in default of the former, or for series of importance containing numerous paleontological horizons.

5. Names etymologically false or badly formed are to be rejected or corrected.

One afternoon meeting was devoted to subjects of petrographic character, and in order to facilitate discussion of the general questions in that department, a special meeting of petrographers, to the number of over fifty, was held, Zirkel presiding. The discussions were animated, centering upon classification, but resulted in the following almost unanimous expression of opinion, which was presented through the council to the Congress:

"It is not desirable, in view of the present rapid development of the science of petrography, to attempt to establish definite principles of classification of rocks by a resolution of the Congress.

"To attain the simplification of petrographic nomenclature demanded by geologists, it is necessary to define with greater precision than has yet been done such general terms as are required in geological mapping."

A resolution presented by Brögger expressed the view that it was desirable and probably practical to establish a international journal of petrography devoted chiefly to reviews and abstracts of the current literature. This resolution excited considerable debate, but was finally adopted and transmitted to the Congress with the request that a committee be appointed to ascertain the feasibility of the plan. The committee named consists of fifteen men, the American members being Iddings and Pirsson.

Papers of interest presented in this department were by Walter, Jena, Versuch einer Classification der Gesteine auf Grund der vergleichenden Lithogenie, and by Loewinson-Lessing, Dorpat, Note sur la Classification et la Nomenclature des Roches Eruptives.

Walter attempts a general classification, his basis being the recognition of primary and of secondary characters in rocks, of which the first alone determines the place in the system. Thus every metamorphic rock, however altered by "secondary characters," is grouped under the rock from which it is derived. He makes four main groups, Mechanical, Chemical, Organic and Volcanic Rocks.

Loewinson-Lessing bases his classification of the eruptive rocks wholly on their chemical composition, expressed in terms of the "oxygen equivalent," and of the proportions of the various oxides.

The Congress endorsed strongly a proposition by Androussoff, Dorpat, for the establishment of an International Floating Institute, or laboratory, for the study of Oceanography, to be supported by various Governments in place of the isolated expeditions sent out for this purpose from time to time by different ones.

The invitation of the French geologists to hold the next session of the Congress in Paris in 1900 was accepted. A bulletin was distributed showing the proposed excursions to Brittany, to Normandy, and, after the session, to the Central Plateau and the French Alps.

A sad incident of the Congress was the sudden death in St. Petersburg of one of its members, Spendiaroff, Dorpat, who had taken part in the Ural excursion and was to have been a leader during a part of the Caucasus excursion. At the closing session of the Congress it was announced that the father of the deceased had presented a sum of money to commemorate his son, the interest to be awarded as a prize for the best paper on a stated subject at successive meetings of the Congress.

Numerous festivities and excursions were a part of the week's program at St. Petersburg. The Tsar received in audience at his palace of Peterhof, a small number of the more distinguished representatives of each country. At a later day, but in his absence, the whole Congress visited the palace and beautiful grounds, journeying down the harbor by steamer and enjoying a luncheon in the magnificient imperial dining hall.

Another day was devoted to a visit to the cataract of Imatra in Finland, a hundred miles north of St. Petersburg, where a sumptuous banquet was served in a pavilion erected for the purpose on the edge of the thundering torrent.

Among the entertainments in St. Petersburg, the most notable were the reception by the Grand Duke Constantine at his palace and that by the Mayor and city officials at the City Hall. Many pleasant reunions took place at the German Club which was placed at the disposal of the members during the session. The museums and collections of the city were made easy of access through special open hours, and their manifold attractions doubtless were to blame for the frequently slim attendance at the meetings.

The close of the session was marked by the departure of a large proportion of the members for Moscow, the starting point of the three excursions which journeyed by different routes toward the Caucasus and the Crimea. Upward of four hundred people participated in these excursions which promised so many and so varied interests.

SOME UNWRITTEN HISTORY OF THE NAPLES ZOOLOGICAL STATION.

All American biologists are familiar with the Zoological Station at Naples, either through having enjoyed its unrivalled facilities or from accounts of it which have been published again and again in the journals, both scientific and popular, of the two worlds. It is, beyond question, the greatest establishment for research in the world. But while it occupies this position to-day, and while its history since it first threw its doors open to the investigator is a part of the history of biology, the station has an unwritten history which is extremely interesting, especially since it shows, in strongest light, the indefatigable industry and resourcefulness of its founder and director, Dr. Anton Dohrn, in overcoming obstacles of every sort, many of which would have discouraged a man of less persistence. On the evening of August 10, 1897, Dr. Dohrn told the students at the Marine Biological Laboratory at Woods Holl, some of the difficulties which he encountered before the station was ready for students. His talk is summarized in the following account, his own words being used in some cases.

After apologies for possible linguistic mistakes due to the use of a foreign tongue and for the prominence of himself in what he had to say, Dr. Dohrn continued by asking his audience to imagine a young privat-docent of the University of Jena, with rather more money than he well knew how to spend; with more time than he knew how to use, but with a strong desire to do something of lasting benefit for science, and you have an idea of one of the factors in the foundation of the Naples Station. This young man had already opened a small laboratory in a modest way at Messina, but it was far from meeting his ideals. Location, equipment, support, were not the best imaginable.

On his return journey to Germany several points were visited and critically examined as to availability for a large station, and Naples seemed in every respect to promise best, but the great problems were how to get the proper location, how to obtain the necessary influence and support. For a young doctor with a reputation to make and with only the money granted by an indulgent father, both obstacles were rather serious.

One day in the late sixties, while returning from Berlin to Jena, an idea came which promised, at least in part, to remove some of the difficulties; it was to combine with a station for research, an aquarium for the entertainment of the people. Both Hamburg and Berlin had aquaria which were most successful, why should not Naples be equally favorable? So back to Naples he went at once.

At this time Naples was making great preparations for a Maritime Exposition, and it was thought that the aquarium project would work in well with this, and that, the exposition over, the building could continue and develop its scientific side. The director of the exposition was interviewed; he favored the plan, and arrangements were at once made by which the aquarium was to be inaugurated as a part of the exposition, the young privat-docent in his eagerness and enthusiasm, agreeing to meet all bills, while the director was to assume charge of the plans and the ordering of the material and equipment. Soon Dr. Dohrn saw his mistake. The director planned as he liked, ordered as he liked and soon bills came in for things totally different from anything which Dohrn himself would have ordered. So there was a break in the arrangements, and the privat-docent was back exactly where he was before—location and support still to be obtained.

He drew up a few plans, designed an elevation of the building he desired, and with these he aroused the interest of Professor Panceri of the University of Naples, who advised a consultation with the authorities of the city, who had then in progress plans for a park or garden on the shores of the beautiful bay. They, too, were attracted by the project and designs, and since they were to have the aquarium free of expense to the city, the very location desired was granted, the grant, however, being coupled with several conditions. Some of these restrictions were almost laughable. Thus no one was ever to sleep in the building, and when it was pointed out that the proprietor of the restaurant in the garden spent the night in his building, the reply was made that this was an exception. Again, it was stipulated that there should be no kitchen connected with the station, the reasons for this proviso being that if there were a kitchen it would be so easy to convert the structure into a hotel, and it would never do to have a hotel in the gardens. The other restrictions were far more serious, and Dr. Dohrn felt that he could not subscribe to the agreement in the shape it was presented to him by the Naples council. At this juncture he applied to the Italian Government, which then had its seat at Florence, and in a few days received the characteristic advice, "subscribe to everything, and then do as you please," advice which later was to make trouble for him.

Then came the Franco-Prussian war and the station plans were set aside for a time, for Dr. Dohrn was ordered to his regiment, and he went to France to take part in that struggle. When the war was over he was soon back in Naples. An architect was engaged and the station and its aquarial adjunct seemed on the straight road to accomplishment. But this bright prospect was soon darkened. The architect, like others of his class, had his own ideas of what a zoological station should be like, although up to the moment of his engagement he had never seen such an establishment, nor had he ever dreamed of one. At last he returned with his plans, Dr. Dohrn glanced at them, saw that they were totally unfitted for a zoological station and pushed them aside on the table, whistling, as he did so, the closing phrases of Beethoven's Ninth Symphony, a reminiscence of a concert of the evening before. The architect rushed from the room in rage, and shortly his representative called upon Dr. Dohrn to make arrangements for a duel. The matter was finally settled, the architect received a thousand francs for his unusable sketches and another was installed in his place.

At last actual building was commenced and slowly the walls went up. Dr. Dohrn's father was dead and the patrimony was all invested in the new building. Three times the projector was at a loss as to from where the money for the week's payment was to come, and at as many times were friends found who aided in the undertaking. At last all resources were exhausted, friends had given all they could, Dr. Dohrn's private fortune had gone into brick and iron and marble. The thought came, this station is to be educational in its ends, cannot the German Ministry of Instruction be induced to aid by giving the 30,000 marks necessary to finish the building.

So there followed another trip to Berlin. Dr. Dohrn called on the Minister, told his story and asked if the Government could make such a grant and received for an answer, "no." As Dr. Dohrn tells it, the Minister made no attempt after this refusal to close the interview, but seemed to wait as if the answer were not final, but as if he were still open to conviction upon proper argument, and so the Doctor told a story to the effect that after the battle of Sedan he obtained a leave of absence to attend the meeting of the British Association for the Advancement of Science. When in England a friend commented upon the Franco-German war and the successes of the Germans, to the effect that this was a beginning of the end of the German pre-eminence in intellectual matters; that now Germany would develop into a military power and in all other respects would fall behind. "For years" said he, "we have been translating books from the German, in the next ten years you will be translating English books into German." The moral of the story was appreciated and the Minister promised that if Dr. Dohrn could obtain the endorsement of the

Berlin Academy of Sciences the desired grant would be forthcoming.

So Dr. Dohrn immediately interested the sympathies of three of the most prominent members of the Academy, Helmholz, DuBois Reymond and Virchow. They promised their aid and assured him that the desired endorsement would be forthcoming, and, rejoiced by the good prospects, back he went to Naples, only to find new troubles which he had never suspected.

In the agreement with the municipality it was stipulated that the station building should not exceed a certain heighth, but the architect whose discharge has already been mentioned, had gone to the officials and had shown them that the walls were nearly a metre higher than was permitted, a fact which was really the result of this architect's own act. He was taking his revenge.

There was trouble immediately. The papers were filled with denunciations of the young German who had thus dared to violate the stipulations of the city, and many there were in the council who demanded that the whole building should come down. Certainly the prospect looked blue enough, but there was more to follow. On that very Christmas eve word was received from Berlin that the Academy had refused to endorse his petition, and that the ministry consequently refused to grant the necessary money. The grounds for non-endorsement were that the aquarium gave the enterprise a mercenary rather than a scientific aspect, and, again, that Dr. Dohrn had as yet done no scientific work that gave him the standing necessary for the head of such an establishment. Dohrn immediately wrote his friends, but was in Berlin before his letters. He personally called upon every member of the Academy, and such were his representations that he received the desired endorsement at the next meeting of the Academy, and the grant of funds immediately followed.

There still remained the matter of the quarrel with the city of Naples. In this Dr. Dohrn thought that possibly diplomacy could be made to play a part, and so the German Crown Prince was interested in the matter and shortly the Government at Berlin began to exert its influence upon the powers of Italy. Long before this, however, Dohrn was back in Naples, where, upon his return, matters were even more unpromising than upon his departure. Soon the results of diplomacy began to make themselves felt, while Dr. Dohrn used his own influence with the officers of the city. Soon he had won to his side a member of the clerical party, and in a short time every obstacle on the part of the municipality was removed.

The building was at last completed and the time came to turn the water into the huge aquarial tanks, which have since proved such an attraction in the station. Here was more trouble. In Naples when a water-proof surface is needed it is the custom to use, instead of cement, a kind of volcanic earth beaten tightly together with rammers. So the builders used this for the bottom of the tanks regardless of the fact that they were to withstand salt water instead of fresh, and this some feet, instead of a few inches, in depth. The water poured through these bottoms in streams. This part of the work had to be done over again.

At last the station was opened and students began to come. There was a demand for such a place and the station fulfilled the demands made upon it as no other institution could. Yet it lived from hand to mouth, and many were the desirable features which must be omitted from the lack of funds. The whole was started, but it was far from the ideal station which its director had in mind. It was at this juncture that the German Embassador to the Italian Government visited the station. He was pleased with all that he saw and impressed with the needs of the enterprise. "I think" said he, "that the difficulties are not insuparable," and shortly after, as a result of his representations to the German Government, backed as they were by the endorsement of Virchow, DuBois Reymond and Helmholz, the Reichstag granted an annual subsidy of $40,000 to the Naples Zoological Station.

WIND RIVER AND BRIDGER BEDS IN THE HUERFANO LAKE BASIN.[1]

By Henry Fairfield Osborn.

In 1888 Professor R. C. Hills, of Denver, announced his very important discovery of tertiary beds in the Huerfano River basin of southern Colorado. He contributed three papers to this subject in the Proceedings of the Colorado Scientific Society in 1888, 1889 and 1891, and finally divided the beds into three series, namely:

Huerfano Series (Eocene)	Huerfano Bed	Bridger Group	3,300.
	Cuchara Beds		300.
	Poison Canon Beds	Lower Eocene (Green River Wasatch and Puerco)	3,500.

The identification of the Huerfano Beds proper was made by means of a large collection of fragmentary fossils. The identification of the lower beds was upon stratigraphic evidence only, Professor Hill observing that they underlay conformably the upper beds. The essential features of his conclusions were as follows:

(1) That the Huerfano series of 3,300 feet are equivalent to the Bridger or middle eocene, and the Cuchara and Poison Cañon series are probably equivalent to the lower eocene.

(2) At the close of the Laramie period a great anticlinal axis arose to the east and southeast of the Wet Mountain Range and east of Spanish Peaks, forming the eastern border of the lake, extending fifty miles north and south, and from ten to twenty miles east and west.

(3) The eruption of the laccolithic Silver Mountain and Spanish Peaks was subsequent to the Upper Lake Deposits of Bridger age. Hence these deposits are found upon the slopes of Spanish Peaks.

(4) The drainage of the Huerfano Lake was to the north through the Wet Mountain Valley.

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[1] Read before the American Association for the Advancement of Science at Detroit.

In May, 1897, the writer accompanied by Dr. J. L. Wortman, made a brief reconnaissance of this basin, and came to the following conclusions; differing from those reached by Professor Hills:

(1) That west of the Huerfano Cañon the variegated marls, clays, soft shales and sands aggregate only 800 to 1000 feet in thickness, are nearly horizontal in position, and constitute alone the true Huerfano Lake deposits. They may be positively divided into Upper Beds, equivalent to the Bridger. From the observations and conclusions made in the basin there are also undoubtedly Lower Beds, equivalent to the Wind River.

(2) That the so-called Cuchara and Poison Cañon Beds are unconformable with the Huerfano and are of older age, probably of Cretaceous, as partly determined by the presence of Baculites in the Poison Cañon section, which was selected by Professor Hills as typical.

(3) That the eastern boundary of the Huerfano Lake is partly indicated in the present cañon of the Huerfano River; that this boundary extended to the south so as to include the base of Silver Mountain toward the Cuchara Divide; that it lies from three to seven miles west of the 'anticlinal axis' described by Professor Hills, and that, therefore, the Huerfano Lake deposition did not extend as far to the east or south as the Spanish Peaks.

The geological features of these conclusions can hardly be dignified by the term " A theory of the Huerfano Lake," for they were formed during a hasty survey of this basin; while Professor Hill's results certainly deserve the deliberate consideration of a prolonged survey. In fact this basin with its volcanic disturbances and eruptions presents a fascinating problem in the geology of tertiary times. Among the Bridger forms discovered were many portions of the skeleton of *Tillotherium*, beside remains of *Hyrachyus*, *Palæosyops*, *Microsyops*, *Calamodon*, *Stypolophus* and *Pachynolophus*. This region is peculiar in the absence of *Uintatherium*. In the Lower Beds are found teeth and limb bones of *Coryphodon*, *Lambdotherium*, *Oxyæna*, *Pantolestes* and other Lower Eocene forms, probably of Wasatch age.

The writer is greatly indebted to Professor R. C. Hills for his very full information in regard to the topography of the basin, and for assistance and advice in connection with the trip.

PECULIAR ZONAL FORMATIONS OF THE GREAT PLAINS.

By Frederic E. Clements.

The traveller through the sand hills of Nebraska has often brought to his notice the striking way in which nature has marked, as though for all time, the fields and groves which once dotted the country. Such areas are always most conspicuous, because of the strange contrast between their sharply marked dark green and the thin, brown vegetation of the sand hills. Frequently the waste is a flaming mass of the western sunflower, *Helianthus petiolaris,* in which case it is distinctly visible for several kilometers. In many localities, such wastes have existed for more than a score of years, and, instead of diminishing in any respect, become each year more and more accentuated.

The elevated prairies and tablelands, which are so typical of the Great Plains before the latter rise into the foot hills of the Rocky Mountains, are characterized by a floral covering monotonous in the extreme. Trees and shrubs are entirely absent, and undershrubs are present only in peculiar alkaline areas, and in "bad lands." The color-tone of the floral covering is green only for one or two spring months: after the first of June, it becomes a uniform straw color, stretching in all directions to the horizon. The two principal formations of the high plains of western Nebraska are the *Stipa comata* formation, and the peppergrass-cactus formation. Rarely, the former is traversed by a sandy zone several kilometers wide and 20–30 kilometers long, characterized by the *Artemisia filifolia* formation. An individual of *A. filifolia* regarded alone is scarcely green, but the mass of individuals, by contrast with the straw-colored Stipa, give a dark green tone to the formation. The floral covering, composed of the Stipa and the peppergrass-cactus formations, is seamed here and there with old, abandoned trails, and what may by courtesy be called roads. These have necessarily originated extremely narrow, but often very long, minor tensions between the original floral covering and the invading roadside flora. Along the roads travelled at present, these tensions have attained expression in a narrow zone at either side. In some instances, this zone consists of dwarf individuals of *Helianthus petiolaris*, in others of *Malvastrum coccineum*, or of *Gutierrezia sarothræ*, in still others, of dwarfed plants of *Salsola tragus*, closely appressed, but conspicuous on account of the unusual deep green color. Not infrequently, Malvastrum and Salsola intermingle to constitute the zone. A common result of such a tension in the Stipa formation is to accentuate the size, and density of growth of the Stipa to such a degree that the formation is bordered along the road by a most conspicuous zone composed wholly of its own facies. In the same formation, the Stipa zone is sometimes suppressed, and its place is occupied in part by scattering, silver-purple bunches of *Artemisia frigida*. In trails a long time abandoned, the sterile strip between the bordering zones disappears, being encroached upon and vanquished by the plant constituting these zones. Such trails then become not only striking members of the floral covering, but not altogether canny features of the landscape as well. From the base of Scott's Bluff, a deeply sunken trail extends far toward the Wild Cat mountains in the southeast, marked over sun-browned plain and ridge by an endless band of dark green, due to the dense bunches of *Gutierrezia sarothræ*. The stage-road from Harrisburg over the hills and undulating plains of Kimball county is flanked on either side by a trail, once well-worn, but now densely crowded with the silver-purple tufts of *Artemisia frigida*. These floral land-marks run parallel to the stage route for perhaps a half-score of kilometers, then swinging abruptly to the southwest, they pass on over valley and ridge, disappearing in the one only to reappear upon the other, until the eye refuses to follow further.

It is impossible to determine how long such subruderal formations have persisted. The size and thoroughness of establishment of Gutierrezia and Artemisia would indicate occupation for several decades. After a long period, however, it usually happens that *Stipa comata*, driving out the subruderal inhabitants, reconquers these trails. It is significant that the dark patches of *Opuntia humifusa*, or *O. polyacantha* so characteristic of this formation, never reappear with the Stipa. But even the speargrass is unable to resist the modifying influence of the trail, and its abnormally tall stems and compact growth find easy interpretation in connection with the ruts and ridges on which it grows. The old California trail is the most interesting example of this. Throughout the upper valley of the North Platte in Nebraska, this historic overland route is marked by such a zonal formation. From the base of Scott's Bluff, the California trail, first travelled more than three-score years ago, and abandoned for over a score of years, "angles" southeastward in a broad band of innumerable ruts, painfully insistent in their matted cover of bleaching grass-stems.

THE CRICKET AS A THERMOMETER.

By A. E. Dolbear.

An individual cricket chirps with no great regularity when by himself and the chirping is intermittent, especially in the day time. At night when great numbers are chirping the regularity is astonishing, for one may hear all the crickets in a field chirping synchronously, keeping time as if led by the wand of a conductor. When the numbers are so great, the resting spells of individuals are unnoticed but when the latter recommence they not only assume the same rate but the same beat as the rest in that field. The crickets in an adjoining field will have the same rate, that is, will make the same number of chirps per minute, but with a different beat as one may easily perceive by listening.

The rate of chirp seems to be entirely determined by the temperature and this to such a degree that one may easily compute the temperature when the number of chirps per minute is known.

Thus at 60° F. the rate is 80 per minute.

At 70° F. the rate is 120 a minute, a change of four chirps a minute for each change of one degree. Below a temperature of 50° the cricket has no energy to waste in music and there would be but 40 chirps per minute.

One may express this relation between temperature and chirp rate thus.

Let T. stand for temperature and *N*, the rate per minute.

$$T. = 50 + \frac{N - 40}{4}$$

For example. What is the temperature when the concert of crickets is 100 per minute?

$$T. = 50 + \frac{100 - 40}{4} = 65°.$$

EDITOR'S TABLE.

—ONE of the most important advances based upon scientific researches is now under discussion in Boston. The Associated Boards of Health of Massachusetts now advocate the licensing of every person engaged in the milk business, the licenses only to be granted after the thorough inspection of the locations of the business and the sources of the supply, even to an examination of the cows. Within the past year several severe epidemics of typhoid fever in and near Boston have been traced to milk supplies, and the very source of infection found. Only a few years ago milk was looked upon as the very safest drink and food for mankind, but one has only to consider the facts brought out by Prof. W. T. Sedgwick in his report upon milk to the Associated Boards of Health to see that we must sooner or later come to some governmental supervision in this matter, for as the case now stands in our cities, milk is about the most dangerous substance that enters our houses.

—EVERY one who reads the foreign journals is frequently gratified by the praise they accord to our government publications. Typography, illustration and the matter itself all come in for commendation. There is, however, one department of our government with which fault must be found in this respect—the Department of Agriculture. Here the fault lies in the multiplicity of serials issued. It would seem that in this department each head clerk considered it necessary to issue his own publication, and, in many cases, several series of publications. The result is that in the present decade there have issued from this department about one hundred series of documents, so that students and librarians have great difficulty in keeping track of them. Then, too, these serials are unduly padded, the truly valuable matter which occasionally appears in them being buried among a mass of valueless material, apparently prepared from a spirit of rivalry between the different bureaus and divisions.

The following list of publications is probably not complete, but it is published here for two reasons: first to show the senseless extent to which this division into series has been carried; and, second, as an aid to librarians in arranging these publications and noting deficiencies.

The Department of Agriculture issues the following publications which are not distributed among the separate bureaus: Circulars, Miscellaneous Circulars, Farmers' Bulletins, Special Reports, Miscellaneous Special Reports, Reports of the Secretary, Year Book—a total of seven.

From the separate divisions appear the following:—

Bureau of Animal Industry: Circulars, Circulars of Information, Bulletins, Special Bulletins, Annual Reports.

Division of Soils: Bulletins.

Division of Agricultural Soils: Bulletins.

Division of Agrostology: Circulars, Bulletins.

Division of Biological Survey: Circulars, Bulletins.

Division of Botany: Bulletin (octavo), Bulletin (quarto), Circulars, Contributions from the U. S. National Herbarium, Special Bulletins, Illustrations of North American Grasses, Report of the Botanist.

Division of Chemistry: Bulletins, Circulars, Report.

Division of Entomology: Circulars, Circulars (second series), Bulletins, Bulletins (new series), Periodical Bulletins, Special Bulletins, Technical Series, Reports, Insect Life.

Division of Forestry: Circulars (octavo), Circulars (quarto), Bulletins (octavo), Bulletins (quarto), Reports upon Forestry, Report of the Chief of the Division of Forestry.

Division of Garden and Grounds: Report.

Division of Microscopy: Report, Food Products.

Division of Ornithology and Mammalogy: Bulletins, Reports, North American Fauna.

Division of Pomology: Bulletins, Circulars, Report of the Pomologist, Report of the Assistant Pomologist, Special Reports.

Division of Publications: Circulars, Reports.

Division of Records and Editing: Report.

Division of Statistics: Circulars, Crop Reports, Miscellaneous Reports, New Series Reports, Special Reports, New Series Miscellaneous Reports, Miscellaneous Series Bulletin, Miscellaneous Series Reports, Reports of the Statistician.

Division of Vegetable Pathology: Bulletin, Circular, Report, Journal of Mycology.

Division of Vegetable Physiology and Pathology: Bulletin.

Fibre Investigation Series.

Library (octavos).

Library Bulletin (quarto).

Office of Experiment Stations: Circulars, Experiment Station Bulletin, Experiment Station Record, Miscellaneous Bulletin, Bulletin, Reports.

Office of Irrigation Inquiry: Bulletin.

Office of Road Inquiry: Circular, Bulletin.

Section of Foreign Markets: Circular, Bulletin.

Seed Division: Report.

Silk Section: Circulars, Bulletins, Reports.

Weather Bureau: Annual Summary of New England Weather Service, Bulletin, Bulletin of New England Weather Service, Lake Storm Bulletin, Monthly Weather Review, Report of Ohio Weather and Crop Service (octavo), Ohio Section of Weather and Crop Service (quarto), Report of the Chief, Weather Crop Bulletin, Report of the North Dakota Weather and Crop Service, Circulars of Information.

This list is, we think, sufficient to support our contention that multiplication of serials in the Department of Agriculture has been carried to an absurd extent. It is high time that the Secretary call a halt and give the "Division of Records and Editing" a blue pencil and the authority to use it.

General Notes.

GENERAL BIOLOGY.

Reactions to Stimuli in Paramecium.[1]—The plan of the author has been to study the reactions of one organism so completely and exactly that we may gain a good idea of its daily activities. Phenomena such as these are to be explained. When a large number of Paramecia are transferred, together with a bit of decaying vegetable matter, from the culture jar to the glass slide and covered with a properly supported cover-glass, we see the Paramecia at first uniformly distributed, a few minutes later beginning to gather about the decaying particle, and soon all accumulated there. Some minutes later the Paramecia begin to disperse, but are always sharply confined within an ever extending circumference. If an electric current is now passed through the water, the infusoria swim towards the cathode, but do not pass the circumference. We seek an explanation of the aggregation of the infusoria, their subsequent dispersion and their limitation by an invisible boundary, even when urged to pass it by the electric current.

The results of a series of experiments which cleared up one difficulty after another in a manner very interestingly described are as follows: The beginning of the accumulation of the Paramecia is due to thigmotaxis. An individual, hitting the solid body by chance, stops, perhaps starts back and whirls on its axis, then settles against the object and remains there. Others do likewise; thus the accumulation begins. No response occurs to smooth hard bodies. The close application of the Paramecium to the surface and the gliding over it are the results of the peculiar reactions of the cilia induced by the stimulus. But the rapid and complete aggregation cannot be accounted for alone on the ground of thigmotaxis. The author finds that *Paramecia are attracted by a not too strong concentration of carbon dioxide.* The CO_2 produced by the thigmotactic individuals serves to lure the others. But after the crowd has become very dense the CO_2 becomes so strong in their vicinity that the Paramecia are repelled from the region of the solid body and begin to disperse. They do not scatter widely into the culture

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[1] H. S. Jennings. Studies on Reactions to Stimuli in Unicellular Organisms. I. Reactions to Chemical, Osmotic and Mechanical Stimuli in the Ciliate Infusoria. Jour. of Physiology, XXI, p. 258–332, May, 1897.

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fluid, however, for they are repelled by the latter also, but they keep in a zone of weak concentration of CO_2. The chemotactic movements of Paramecium were seen also in their repulsion by strong solutions of all acids, including CO_2, by all alkaline solutions, to which category the culture fluid belonged, and to certain neutral salts and organic compounds. Towards other organic substances, e. g., sugar, glycerine, urea, Paramecia is indifferent. Tonotaxis plays no important part in the normal activities of the organism. The reason why the infusoria are not forced beyond the circumference by the electric current is that they are less strongly electrotactic than chemotactic.

The following weighty conclusion is now drawn: Since infusoria are negatively tactic to their native fluid and positively tactic to the unadvantageous CO_2, negative or positive taxis is not necessarily an adaptive movement, is not always determined by its advantage to the species.

PALÆONTOLOGY.

Archegosaurus.[1]—The results of this preliminary paper are based on the rich material of Archegosaurus contained in the "Kgl. Museum für Naturkunde" and the collection of the "Kgl. geologische Landesanstalt" in Berlin. The archegosaurs are preserved in clay-geodes, and in spliting these the bones are generally broken. After the bones had been removed with chisels or fine steel-needles, a mixture of gelatine and glycerine was poured over the plates and very good reliefs of the skeleton were thus produced.

Jäckel intends to write a monograph on Archegosaurus and gives only the more important results. He commences with the skull, and afterwards discusses the vertebral column, the limbs and the dermal skeleton.

The skull.—In the palatal region he finds some differences from the statements so far given. There exist series of teeth on the inner sides of the vomers and palatines, which show essentially the same arrangement as in the Labyrinthodontia. Larger teeth are placed between the anterior ends of the choanæ, and behind these. The choanæ are very much longer than in the Labyrinthodonts. This elongation is certainly in relation to the anterior extension of the muzzle of Archegosaurus.

[1] Jäckel, Otto. Die Organisation von Archegosaurus. Zeitschr. deutsche Geol. Ges. Jahrg., 1896, Heft 3, p. 505–521, fig. 10.

The teeth of both the inner and outer rows are separated by considerable spaces from each other and are less crowded than in the Labyrinthodonts.

The outer side of the lower jaw of *Archegosaurus decheni* is figured. It consists of four sculptured bones. Following E. Fraas,[2] he names the upper element outside of the articular face, the articular, but he doubts whether it belongs to the endoskeleton. This element is the supraangular, the angular is correctly determined, and the "infradentale" is one of the splenials.[3]

The vertebral Column.—There are said to be 25 presacral, one sacral and over one hundred caudal vertebrae. Jäckel believes that there is uncertainty about the morphology of the vertebral column of the Stegocephalia and the higher vertebrata.

Among the Rachitomi he distinguishes four elements: 1. The paired upper arches [neural arches Baur] which in Archegosaurus unite dorsally into a spinous process [neurapophysis Baur]; 2. The paired upper Pleurocentra (Interdorsalia Gadow), which are intercalated between the upper ends of the Hypocentra; 3. The paired lower Pleurocentra, *which in the tail separate themselves from the upper Pleurocentra,* (Interventralia Gadow, Hypocentra pleuralia). 4. The unpaired Hypocentrum which in the tail may split into two centres of ossifications.

First I may mention that the name *Intercentrum,* first introduced by Cope,[4] antedates Gaudry's[5] name *Hypocentrum* five years.

Cope says "The basal portions of the chevron bones are continued throughout the greater part of the Vertebral column in the Permian Genera Clepsydrops, Metarmosaurus and Epicordylus [Eryops], forming intervertebral elements to which I have given the name *intercentra*" —"The free elements of the cervical series of some reptiles are probably the same."

The name Pleurocentrum was introduced by Gaudry[6] in 1879; in the same paper he designated, Cope's intercentrum as "Pièce inférieure du centrum." I do not believe that there has been any uncertainity about the morphology of the vertebral column of the Stegocephali and the higher Vertebrates. The whole question was definitely solved. Everybody is convinced that the pleurocentra of the Rachitomi represent the centra of the higher Vertebrates; and that the intercentra are homologous to the intercentra of the Sphenodontidæ, Geckonidæ, Uroplatidæ, Pelycosauria. These intercentra support in the tail the chevron bones, or hæmal arches; both are firmly united.

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[2] Fraas, Eberhard. Die Labyrinthodonten der Schwæbischen Trias. Palæontographica Bd. XXXVI, p. 73, Aug. 24, 1889.

[3] Baur, G. Uber die Morphologie des Unterkiefers der Reptilien. Mit 4, Abbildungen., Anat. Anz. Bd., XI, Nr. 13, Dec. 21, 1895, p. 410–415.

[4] Cope, E. D. The Homology of the Chevron Bones. AMER. NATURALIST, May, 1875, p. 319 (Published, April 22d).

[5] Gaudry, Albert. Les Enchainments du Monde Animale dans les Temps Géologiques Fossiles Primaires. Paris, 1883, p. 273, fig. 273, A. B. C.

[6] Gaudry, Albert. Les Reptiles de l'époque permienne aux environs d'Autun. Bull. Soc. Géol. d. France. (3) Tome VII, 1878–1879, Paris, 1879, p. 68, and p. 65 in explanation of fig. 7.

In some papers published this year by Dr. Hans Gadow[7] and Prof. Alexander Götte,[8] it is maintained, that the intercentrum of the Rachitomi forms the centrum of the Amniota; Prof. Jäckel comes to the same conclusion. Gadow and Götte have never examined any fossil Stegocephali or Pelycosauria and Jäckel, by some unfortunate calculation, has completely misunderstood the true nature of the archegosaurian vertebral column.

I shall show that this new opinion is in opposition to all morphological facts. In Archegosaurus the rib-heads are articulated below with the intercentrum, behind with the pleurocentrum and above with the pointed base of the neural arch. In the tail the lower arches (hæmapophyses, chevron bones) are united with the intercentra. In the Pelycosauria: Clepsydrops, Dimetrodon, Naosaurus, Embolophorus, Theropleura and others we have exactly the same condition. There are very well developed intercentra between the centra, which are suturally united with the neural arches. The capitulum the lower part of the rib-head is articulated to the intercentrum, the tuberculum to the anterior portion of the centrum and the base of the upper arch. In the tail the lower arches (hæmapophyses, chevron bones) are united with the intercentra.

According to Gadow, Götte, Jäckel the Intercentrum Cope, of the Rachitomi is homologous to the centrum of the Amniotia. There is no doubt, that the intercentrum plus hæmal arch (chevron) of the Pelycosauria is homologous to the intercentrum plus hæmal arch (chevron), of Archegosaurus; therefore the intercentra of the Pelycosauria are centra, according to the authors named above. Therefore, the Pelycosauria have two centra. This of course is absurd, therefore the intercentra of the Rachitomi are not centra, but true intercentra, as everybody has believed so far.

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[7] Gadow, Hans. On the evolution of the vertebral column of Amphibia and Amniota, Philos. Trans. Roy. Soc. London, vol. 187 (1896), B. pp. 1–57. London, 1896, June 16.

[8] Götte, Alex. Ueber den Wirbelbau bei den Reptilien und einigen anderen Winbelthieren. Zeitschr, wissensch. Zool., vol. LXV, p. 343–394.

We only need to examine some of the Stegocephalia in which the ossification of these elements is more advanced. In old specimens of *Eryops megacephalus* Cope, the pleurocentra are closely united to the posterior base of the neural arches; the intercentra are placed between the pleurocentra below and do not reach the neural arches. Only the first intercentrum is connected with the neural arches of the first vertebra the atlas, forming an atlas-ring as in all Amniota. How is it possible that this first intercentrum can be a centrum? The pleurocentra of Eryops are homologous to the centra of the Amniota. The rachitomous condition is the most primitive one. Before Jäckel, I described the condition in Archegosaurus as follows:[9] If we examine the vertebral column of Archegosaurus, we see that the notochord is still developed and that in the dorsal region each body of the vertebra consists of three parts, two lateral ones, the pleurocentra, and one inferior one, the intercentrum (hypocentrum). In the tail region we find even five elements; the two pleurocentra and below them two small hæmacentra Hay[10] (hypocentra pleuralia) and the intercentrum to which the hæmal arches (chevron bones) are attached."

There is very little doubt, that in the caudal vertebræ of the Rachitomi the hæmacentra, if they were present, formed with the pleurocentra a cartilaginous ring. In the precaudal region only the pleurocentra become ossified and support the neural arches. The intercentra were continued dorsad as cartilage, also forming a ring. In the tail the chevrons, lower arches, are united with them. This primitive condition is modified in two ways. First: the *intercentrum* increases in size, especially the lower portions, become broader, until they meet with each other. The *pleurocentra* become reduced, or confluent with the upper arch. The intercentra form the body of the vertebræ of the Labyrinthodontia, they are wedge-shaped, the notochord never passes through the centre, but is placed in an excavation at the upper free border of the intercentrum, or there is a small fossa at the upper posterior face of the atlas, or there may be a chordal foramen just below the upper border. From all this it is evident, that the "centra" of the *Labyrinthodontia* are *intercentra.* This opinion is now generally accepted.

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[9] Baur, G. The Stegocephali. A Phylogenetic Study. With 8 Fig. Anat Anz. XI, Bd., N. 22. Mærz 20, 1896, p. 657–673.

[10] Hay, O. P. On the structure and development of the Vertebral column of *Amia.* Field Columbian Museum. Publication 5. Zoolog. Series. Vol. I, No. I, p. 40. Chicago, U. S. A. October, 1895.

The Labyrinthodonts reached a large size and became extinct at the end of the Trias.

The second modification of the rachitomous condition is seen in Cricotus Cope. Each vertebra consists of two fully ossified elements. The centra in the precaudal region completely support the neural arches, which have well-developed diapophyses. These diapophyses are placed on the neurocentral suture which is, however, completely obliterated. The centra are 15 mm. long, 25 mm. broad, and 25 mm. high; they are very deeply biconcave and notochordal. In front of this centrum is a complete intercentral disc, of the same breadth and heighth as the centrum, but only 8 mm. long; laterally at the posterior border it possesses a small process to which the capitulum of the rib is articulated. These flat intercentral discs have a very large notochordal foramen (4 mm. in diameter). In the tail the intercentral discs carry the chevrons. This condition has been called by Cope *embolomerous* and the suborder *Embolomeri.* It is evident that the *centra* are homologous to the pleurocentra. The Embolomeri became extinct in the Permian. Only two genera are known, Cricotus Cope and Diplovertebron. From the Rachitomi the Amniota developed. The pleurocentra formed the centra, and the *intercentra* were more and more reduced. Intercentra are present between all the vertebræ in the Pareiasauria (Cotylosauria) Pelycosauria, Rhynchocephalia, Geckonidæ, Uroplatidæ. In the Ichthyosauria, and Lacertilia they are confined to the anterior cervical vertebræ. In the Megalosauria, Iguanodontia, Pterosauria and Birds; the first intercentrum forms the lower piece of the atlas ring, and the second intercentrum is united with the centrum of the atlas (odontoid process) and the centre of the axis into one mass. In all mammals the first intercentrum always remains, forming the lower piece of the atlas ring, and in some mammals they are even present in the dorso-lumbo-sacral region, for instance in the Insectivora (Talpa, Erinaceus, Myogale) and in Atherura among the Rodents.[11]

I gave in 1886 a full historical account of the views on the morphogeny of the vertebral column of the Amniota from 1844, giving all the morphological, paleontological and embryological evidence.[12] Dr. Gadow certainly did not study this paper, for, after the quotation of it in his Literature, he puts in parenthesis " Extract, in German, of Cope's discoveries."

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[11] Baur, G., l. c., p. 663.

[12] Baur, G. Uber die Morphogenie der Wirbelsäule der Amniolen. Biolog. Centralbl. Band VI, Nr. 11 and Nr. 12, Aug. 15, 1886, p. 322–342; 353–363.

After the discussion of the vertebral column, Jækel makes some remarks on the ribs, limb-skeleton and the dermal covering, and concludes his paper with a short summary of his results. I hope that Jækel in his final monograph on Archegosaurus will give up the absolutely unfounded opinion of the homology of the intercentrum of Archegosaurus with the centra of the higher Vertebrata.—G. B.

Reconstruction of Phenacodus primævus, the most Primitive Ungulate.[13]—This paper was accompanied by the re-mounted skeleton of Phenacodus and a wax model executed by Charles Knight. As originally mounted in Professor Cope's laboratory, the famous skeleton of *Phenacodus primævus* conveyed a very imperfect impression of its actual form and proportions. Several serious errors were committed by the restorer, the most important of which was the implanting of two of the cervical vertebræ in the tail. The author, therefore, considered it advisable to completely re-mount the animal, and this has been done by Mr. Adam Hermann and Mr. Martin, of the American Museum, at an expenditure of five months time. The animal is placed as nearly as possible in a natural position. It shows that the feet were not plantigrade, or soled upon the ground, but digitigrade, as in the tapir. The body is characterized by the great convexity of the back, characteristic of the Carnivora and of all the early ungulates. A further unguiculate feature is the great development of the hind quarters and of the tail. The disproportion between the hind and the fore quarters is heightened by the extremely small size of the head, containing a brain which was about the size of that of the opossum, as fully described by Cope.—H. F. OSBORN.

BOTANY.

Observations on the Distribution of Plants Along Shore at Lake of the Woods.[1]—Professor MacMillan's paper upon the vegetation of the shores at the Lake of the Woods is the most important contribution to American phytogeography since the Metaspermæ of the Minnesota Valley of the same author. In this paper, as in the latter work, the elements of the flora have been determined with almost exhaustive minuteness, and it is not too much to say that, for a large portion of the two regions in which this territory falls, Professor MacMillan's work upon the floral elements will be found to be substantially final. But in the present paper, the author has done much more. He has given a sketch of the shore and beach vegetation from the standpoint of ecology, and a résumé of the formations which it presents. Although several papers of minor importance have dealt with certain aspects of some ecological and formational problems, Professor MacMillan has undoubted right to the honor of being the first in the field in this country, if not indeed in the English tongue, with an account of extended research in these lines. Pointing this out with pardonable pride, he has offered his contribution as an incentive to others to undertake and to continue a sort of botanical work which stands in need of many investigators. The author is emphatically a man of ideas, as he has demonstrated in more than one department, and his contribution at this time, when investigation in this country is but beginning, is welcome and opportune.

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[13] Read before the British Association at Toronto.

[1] MacMillan, Conway: Observations on the Distribution of Plants along Shore at Lake of the Woods. Minnesota Botanical Studies, I, 949, 1897.

At the outset, it should be noted that the author's standpoint is purely ecological, not phytogeographical. He is concerned solely with the physical environment of the plants of the locality, not with the biological environment that in so many instances proves of no less moment. It is not easy to make distinctions of this sort, since they depend largely upon the point of view of each writer. But, in general, the phytogeographer looks primarily at the floral covering as such. He studies, analyzes, and traces the development of the floral covering as a whole, and in restricted areas. For this purpose, he brings to bear his knowledge of the physical and biological environment and of the plants themselves as well, their morphological adaptations as shown in primary and secondary biological characters, modifications for purposes of duration, seed-production, dissemination and so forth. But the ecological phytogeographers appear to restrict themselves for the most part to the investigation of certain aspects of the relation of the floral covering to its physical environment. This investigation is, without doubt, of great importance, but the limitations of such a procedure appear clearly in the paper under review.

The discussion of the physical conditions prevailing upon the shores at Lake of the Woods is a masterpiece of analysis. Everything has been taken into account, and every modification which might affect the floral covering has been investigated and pointed out. This analysis has been made not only with reference to the more important factors —water-content, illumination and temperature, but also with reference to all minor influences. That portion of the paper dealing with the physical conditions of the locality is the most important, since it suggests methods of procedure for other regions. It deserves study at the hands of all who are engaged with similar problems. But, at the same time, it must be said that for most purposes the analysis will be found too exhaustive. The perception of the relation of habitat and organism stands at the foundation of phytogeography; yet all of the physical factors are not of equal importance. Plants have more to do than merely to contend against physical conditions; they have to contend with other plants. Individuals contend with each other, vegetation form with vegetation form, floral element with floral element, and formation with formation; a struggle goes on everywhere in the floral covering that forces plants to adapt themselves to strange and even unwelcome environments. The influence of modifications due to this necessity is one that may never be overlooked. Extended investigation of a large territory is required to enable one to measure the relative importance of these factors, but it cannot escape notice that a number of species listed by Professor MacMillan are ruderal species of varied habitat, which may be met with in meadow, clearing, high prairie or sand hill, as well as in the situations where he found them. In fact, it is only by beginning at the other end, by studying the vegetation forms of a region and the accessory characters of this vegetation, and so reaching an understanding of the means by which plants are enabled to take possession of the soil and to maintain themselves there, that one can comprehend the really characteristic and dominant vegetation and arrive at an understanding of formations.

The discussion of the biological factors which determine the vegetative covering of the region, therefore, seems quite inadequate. An analysis of these biological factors made with the same minuteness as that of the physical factors, might not be necessary, and yet it cannot fail to suggest itself to those who have been engaged in the study of like problems in other regions, that the former, in general, is likely to be the much more valuable, if carried beyond a certain point. The physiographical and climatological conditions are undoubtedly of controlling force while vegetation is establishing itself in a new area. Once established, vegetation reacts upon its environment and upon itself, and new forces have to be reckoned with. One would think that a more careful consideration of these and of the influence of vegetation forms and their distribution would have made such phenomena, as the occurrence of Celastrus and Parthenocissus in the back-strand rather than in the mid-strand (p. 979) much more clear.

It has been pointed out in a previous paper that the formation is a definite phytogeographical concept, determined by its statistic, vegetation forms and habitat groups. The determination, or better, the recognition of a formation is conditioned by the previous analysis of its constituents from these various standpoints. This fact was first appreciated by the Continental phytogeographers, and Drude was the first to carefully elaborate the formations of an entire flora in accordance with this principle. The fundamental nature of his work in this line renders his researches classic, and his conclusions superlatively final, for the present at least. As is well shown in his Deutschlands Pflanzengeographie, I, it is necessary to first comprehend the floral covering by a careful analysis of its floristic, vegetation forms and habitat groups, and then by even more careful synthesis, determine the formations thus pointed out. While the floral covering may be truthfully likened to a mosaic in which the various pieces are formations, it is not true that every distinguishable bit of difference is a formation. It must likewise be borne in mind that formations are by no means of fixed and absolute expression: they are at all times more or less plastic, manifesting modification, incipience, decadence, and most intimate relations with other formations.

It is, at present, so common to reproach European botanists, and particularly those upon the Continent, for their disregard of the results of American investigation, that it is odd to be obliged to call attention to American neglect of European research. Yet the article in hand manifests justs such a lack of acquaintance with the fundamental contributions of Drude. Drude's concept of the plant formation is undoubtedly to be regarded as the correct one. Measured by this standard, the great number of formations noted for a small area by Professor MacMillan fall in most cases to the rank of facies, or patches, or they are at best only incipient or decadent stages of real formations. The author has committed two serious mistakes in his elaboration of the Lake of the Woods formations: the first is lack of perspective, the second is too minute analysis. It is impossible to delimit formations accurately by studying the floral covering of a restricted area. Such limitation can be done intelligently and well only in a natural vegetation area; except in the rarest cases, in nothing smaller than a vegetation region. A formation must be studied in all its various stations and in its many phases, before final conclusions can be reached concerning its validity. From the lists given, the floral covering in the vicinity of the Lake of the Woods is composed of the most heterogenous elements, which have crowded together in peculiar fashion. Appreciating this fact, then, such a floral covering could be well comprehended only after the exhaustive study of the formations of the entire vegetation region. Had this been done for the present contribution, many of the so-called formations would have been referred to the real formations of which they are immature or incomplete expressions. As a concrete illustration, all of what Professor MacMillan terms surf-barrier formations are merely isolated facies and patches of certain water-plant formations common throughout the Allegheny and Prairie provinces.

In analysing too carefully, the author has noted everything distinguishable as a formation, a method which serves very well for the mere cataloguing of phytogeographical phenomena, but is one scarcely to be commended as affording a basis for work of much value. Upon many such points, one not familiar with the country studied is incapable of passing judgment, but, in some instances, the mistakes are apparent even to one not conversant with the particular floral covering. Front-strand, mid-strand and back-strand represent merely a more or less radially biologically symmetrical formation, the nucleus of which is found in the back-strand, from which the formation "shades out" toward the lake with accustomed zonation. As for strand pools, the three sorts are merely developmental aspects of one formation. The formation is best represented by the back-strand pool, which is simply the ultimate expression of the water plant formation represented in its earlier stages by mid strand and front-strand pools. Dune pools are likewise to be referred to the same formation. Soil shore formations are not at all peculiar to the Lake of the Woods; they are aspects of formations which occur over a large portion of the continent. Talus formations are such only in rare instances; they are usually incipient formations of very various types. It is perhaps unnecessary to point out further instances of such incorrect analysis. It only remains to remark the similarity between the many lists of species of different formations, and to call attention to the large number of meaningless ruderal and subruderal plants contained in them. Formational statistics to be of value must be arranged with reference to facies, principal species, secondary species, etc., and not in bald lists.

—Roscoe Pound,
Frederic E. Clements.

ZOOLOGY.

The Cæcal Appendices of the Orthopteran Mid-Gut.[1]—Continuing his observations on the glands connected with the intestine, Bordas points out that in all the Orthoptera, with the exception of the Forficulidæ and Phasmidæ, the well known cæcal appendices of the grasshopper, though varying in form from family to family, may be recognized. The presence or absence of the cæca corresponds more or less closely with different external morphological characters and allows the orthoptera to be divided into two sections. Moreover, the number of these organs, their disposition, their mode of insertion, the folds presented by their internal surface and especially the presence or absence of posterior diverticula, are characteristics by which a number of families may be recognized. For instance, the Mantidæ and the Blattidæ are provided with 8 intestinal cæca, while the Acridiidæ possess but 6, and the Locustidæ as well as the Gryllidæ possess but 2. From his observations upon numerous specimens, he concludes that a series may be distinguished in which paired appendices stand at one end and multiple appendices at the other, or in other words, that the Pseudophylliniæ connect the Acridiidæ with the Locustidæ.—F. C. K.

For many years one of the problematic structures of vertebrate morphology has been the hypochorda or sub-notochordal rod, a slender cord of tissue developed like the notochord from the entoderm and lying ventral and parallel to the larger and better known chorda dorsalis. Its phylogenetic origin, its function and its fate have been uncertain. In the last number of the Morphologisches Jahrbuch, Bd. xxv, are two papers dealing with the subject. In the first, Dr. K. Franz deals with this structure in the Teleostean fishes. His conclusions in brief are that the structure in question is entodermal, that at no time does it contain a lumen, and that it sooner or later entirely degenerates without contributing any elements to the longitudinal ventral ligament of the vertebral column, a view contrary to that of some observers, but in full accord with broader views of morphology. The second paper is by Professor Hermann Klaatsch, and deals with the morphological significance of the subnotochordal rod. He summarizes his conclusions as follows: The hypochorda is a common possession of the higher vertebrates inherited from their ancestors. It is the rudiment of an organ still functional in Amphioxus, the epibranchial groove. . . . . . In the adult Amphioxus this organ is confined to the branchial region, but in the young it extends farther caudally. The great extension of the rudimentary organ above the gut of the higher forms is a secondary appearance.

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[1] L. Bordas: Compt. Rend. Acad. Sci. Paris, CXXIV, (1897), 376–378.

There exists no ground for the view that the hypochorda arises from metameric dorsal entodermal diverticula. The fate of the epibranchial groove is connected with that of the hypobranchial groove, the modifications of the pharyngeal region causing both to become rudimentary. The hypochorda seems in general to degenerate, yet in part it is retained as an elastic band [see Franz, above]; perhaps its elements also play other roles. The reduction of the hypochorda is of significance of an important advance in the Chordate organism in that it renders possible the development of an unpaired [dorsal] aorta.

It is apparent that our most studied forms will repay new and careful study. A few years ago Dr. H. H. Wilder startled the world with his discovery that many of our salamanders were absolutely lungless, and now Professor F. Maurer, one of the most suggestive of German students, has made a strange discovery with regard to certain Amphibia. It is, in short, that in the oral epithelium of at least some terrestrial forms (Rana, Bufo, Hyla, Salamandra, *Triton alpestris*) capillary blood vessels pass through the basal membrane and penetrate the stratified epithelium. After a full description of the conditions found and a few remarks upon the histological and anatomical considerations, he concludes his paper (in the Morphol. Jahrbuch, Bd. xxv) with the suggestion that no doubt these vessels have an important physiological function in that they with the oral epithelium are concerned in respiration. Histological investigations of the oral epithelium of certain of our turtles where Gage (Am. Nat., xx, p. 233, 1886) has described a respiration in the mouth cavity might prove interesting.

Mr. W. G. Ridewood calls attention (Anat. Anzeiger, XIII, p. 499) to the fact that the cartilages recently described by Mr. White and Miss Foote as occurring in Elasmobranchs, are fully described in the older monographs on these forms.

The view advanced by Gervais and Lucus that Scolopendra is ovoviviparous has remained uncontradicted until the present time. Filippo Silvestri (Atti dei Lincei) now states that last year he discovered a specimen of *Scolopendra cingulata* carefully guarding its eggs under a stone, and in June of this year he has found several specimens with their eggs. The ova are pale yellow, ellipsoidal in shape, measuring 2.5 x 3 mm.—*Nature*, August 26, 1897.

Zoological Articles in Recent Journals.—In Vol. 105 of the Sitzungsberichte of the Vienna Academy, Dr. Franz Werner writes upon the Scaling of the Reproduced Tail in Lizards; Dr. F. Steindacher upon some Zoological Results of the Expedition of the "Pola" to the northern part of the Red Sea; Dr. P. Knold upon the Blood Corpuscles of Vertebrates; and Dr. H. Albrecht upon the Comparative Anatomy of the Mammalian Larynx.

PSYCHOLOGY.[1]

Odor-mixture.—The relation of elementary sensations to the sensation of their compound has given rise to much theoretical discussion. In the senses of sight and hearing it has also been the subject of considerable experimental work. The laws of color-mixture have long since been formulated, and the sequence of the color series, like that of the tone series, is well known. In the domain of smell, owing to practical difficulties that attend the investigation, little progress has been made. Certain odors stand marked as qualitatively distinct, but their relations to one another and the arrangement of their "shades" into a single graduated series has never yet been satisfactorily demonstrated. On the other hand, it has been shown that odor-mixtures (of many odors, at least) give rise to new and qualitatively simple odors, thus resembling the color-mixtures rather than the accords of tone combinations. Zwaardemaker, in a recent work, gives a series of nine distinct classes of odors, into one or other of which he thinks any particular odor can be placed. He resolves compound odors into elements belonging to two or more of these classes. When the organ of smell is fatigued for one class of odors, the remaining elements in the compound are sensed, and if the compound consists of but two elements they may readily be distinguished by this means. Both this author and Aronsohn, an earlier writer, speak of certain odors which do not combine to form a mixture, but when placed together give rise to a *blended* sensation, each element of which may be sensed separatively at will. In some compounds, again, one element predominates so strongly that the other is wholly indistinguishable.

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[1] Edited by Howard C. Warren, Princeton University, Princeton, N. J.

Nagel has lately taken up the investigation[3] by a different method—that of simply sensing the various compounds without fatiguing the organ of smell. As a result of his investigations he concludes that odor-mixtures without exception follow the law of color-mixture. When one element of a compound extinguishes the other it is because the former is of far greater intensity; but by reducing this intensity sufficiently a combination is at length reached in which the two unite to form a true mixture. He therefore takes exception to the earlier view, and believes that any two odors can be mixed in such proportions as to produce, at least momentarily, the sensation of a simple odor, of a quality distinct from the components. Whether the new odor is sensed as such permanently, or not, depends on the condition of the sense-organ; if the latter is less fatigued for some of the elements than for others, the former will gradually tend to predominate. The true color-mixture—that in which none of the elements predominate—"resembles each of its components, without, however, being like them." Thus the principles of odor-mixing, according to Dr. Nagel, are similar to those of color-mixing; and the correspondence extends, as far as the author's observation goes, to the law of intensity; the intensity of an odor-mixture is never stronger than that of its components. The author has found several pairs of odors that are more or less complementary and produce an almost odorless mixture, though he has never succeeded in reaching this limit. As regards the arrangement of simple odors into a series, Dr. Nagel's experiments do not tend to verify the classifications hitherto proposed; but he does not venture upon a classification of his own, since he has been unable to discover any odors which can be regarded as really "elementary."—H. C. W.

Psychology at the British Association.—At the Toronto meeting of the British Association, last August, a cordial invitation was given to psychologists to participate. There being no Psychological Section in the Association, the department was assigned to Section I (Physiology), and Dr. Kirschmann, of Toronto, was appointed a secretary of that Section to represent the interests of psychology in the arrangement of the program.

Among the papers of special psychological bearing presented in the Section were the following: On visual reaction to intermittent stimulation, by Dr. Grünbaum, of Cambridge, England; on the nature and physical basis of pain, by Prof. L. Witmer; on the physiology of instinct, by Prof. Lloyd Morgan; and two on various problems of animal psychology, by Prof. Wesley Mills. Physiological psychology was well represented on the program. Prof. H. P. Bowditch discussed the rhythmic action of smooth muscles, and Prof. Carl Huber, of Michigan, reported experiments on the innervation of motor tissues with special reference to nerve endings in the sensory muscle spindles; Prof. F. S. Lee, of Columbia, read a paper on the ear and lateral line in fishes, in which he discussed the bearing of the semi-circular canals on the sense of equilibrium; and Prof. W. P. Lombard, of Michigan, discussed the effect of frequent excitations on the contractility of muscle. One session was devoted to the demonstration of physiological and psychological apparatus. Prof. Lombard exhibited a new and inexpensive type of chronograph. Prof. Scripture demonstrated the use of the Pendulum Chronoscope as a means for measuring small periods of time, and exhibited a "tricolor lantern" for illustrating the laws and effects of color combination. Prof. C. S. Sherrington performed some experiments in visual contrast and upon the flicker phenomenon; and Dr. J. H. Kellog exhibited a new dynamometer, especially adapted for clinical use. A combined meeting of the physiological and botanical Sections was held for the discussion of the chemistry and structure of the cell; Profs. Meldola, J. R. Green, and Macallum contributed papers at this session.

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[3] Zeitsch. f. Psychologie, 1897, XV, p. 82.

In addition to the foregoing, a number of papers having a distinctly psychological bearing were presented in Sections H (Anthropology) and D (Zoology). At one session of Section H several papers on Indian customs and folk-lore were contributed by Miss Fletcher and Messrs. Hill-Tout, R. N. Wilson and Hagar. At another session of the same Section reports were presented on the subject of anthropometric measurements in the schools, and the treatment of dull and slightly abnormal children. A paper by Dr. Franz Boas was read, embodying a statistical examination of the growth of Toronto school children; Prof. Witmer reported the results of some comparative tests—both mental and physical—between white men, white women and Indian men. The Presidental Address of Section H, by Sir. W. Turner, was an examination of some of the distinguishing characteristics of human structure.

In the zoological Section the subject of variation and selection received some attention. Prof. C. S. Minot spoke on the origin of vertebrata, and Prof. H. F. Osborn on the origin of mammalia. Prof. E. B. Poulton discussed the value of mimicry as evidence of the truth of Natural Selection; Mr. W. Garstang, of Plymouth, England, spoke on Recapitulation, and Prof. Lloyd Morgan on the natural history of instinct. Two papers bearing on the genetic problem were also given in the anthropological Section; one by Mr. George Iles entitled: "Why Progress is in Leaps;" and a note by Prof. J. C. Ewart on the transmission of acquired characters.

Considerable material of interest and value to the psychologist was presented in these and other papers. The arrangement of the program, however, though admirable in most ways, was not especially suited to the exigencies of the department. Through the dividing up of these papers among three different Sections some were found to conflict with with each other; at best the auditor was compelled to watch his time closely, and literally *pursue* his subject from one building to another.—H. C. W.

SCIENTIFIC NEWS.

The Ninth Annual Meeting of the Association of Economic Entomologists was held at Detroit, Aug. 12–13, 1897.—The address of the retiring president, Prof. F. M. Webster, treated of "The Present and Future of Applied Economic Entomology in the United States," and contained, among other very interesting features, a tribute to the value of the systematist and a somewhat caustic criticism of the "species maker," helpful suggestions for the experiment station worker, and a very frank discussion of the unfortunate results which attend the attempts sometimes made to combine politics and science. Seven were elected to active membership and three foreign members were elected: The Association now consists of 93 active and 31 foreign members. Seventeen papers were presented during the sessions of the Association.

Resolutions were passed requesting the publication of the proceedings as bulletin of the Divsion of Entomology, U. S. Dept. of Agriculture and expressing familiarity with the efforts of the state of Massachusetts to exterminate the gypsy moth and commending the results already accomplished.

The election of officers resulted as follows: President, Herbert Osborn, Ames, Iowa; 1st Vice-President, Lawrence Bruner, Lincoln, Neb.; 2nd Vice-President, C. P. Gillette, Ft. Collins, Colo.; Secretary-Treasurer, C. L. Marlatt, Washington, D. C. The next meeting of the Association will be held at Boston, Mass., Aug. 19–20, 1898.

The Archæological Institute of America is about to commence the regular and uniform publication of its papers, reports, and other documents. For this purpose it has obtained control of the American Journal of Archæology, formerly edited by Professor Forthingham.

The new series of the Journal will be conducted by an editorial board chosen by the Council of the Institute, Professor John H. Wright, of Harvard, being the Editor-in-Chief. The publishers will be the Macmillan Company, New York.

The Academy of Sciences at Berlin has made the following grants in the aid of research :—Prof. Engler, 2000 mk. for African botany; Dr. R. Hesse, 500 mk. (eyes of lower marine animals); Prof. H. Hürthle, 850 mk. (study of muscles); Prof. Cohen, 1500 mk. (meteorites); Dr. G. Lindau, 900 mk. (Lichens) Prof. R. Bonnet, 800 mk. (blood vessels); Dr. Lühe, 2000 mk. (fauna of north African salt lakes); Prof. F. Frech, 1500 mk. (geology); Dr. G. Brandes, 300 mk. (Nemertines).

The total attendence of the German Universities for the summer semister of 1897 is reported as follows: Berlin, 5163; Munich, 4033; Leipzig, 3221; Bonn, 2015; Breslau, 1646: Halle, 1641; Freiburg 1544; Würzburg, 1443; Heidelberg, 1322; Tübingen, 1301; Göttingen, 1229; Erlangen, 1153; Marburg, 1097; Strasburg, 1047; Greifswald, 853; Kiel, 764; Jena, 754; Konigsburg, 737; Giessen, 692; Rostock, 509; Münster, 497.

We learn from the Botanical Gazette that Mr. William Wesley Woolen, a prominent citizen of Indianapolis and a member of the Indiana Academy of Sciences, has indicated his intention of presenting to the city a tract of fifty-six acres of land to be used as a botanical garden and ornithological preserve. The tract is easily accessible and is admirably adapted to these purposes. The details of management, etc. are now under consideration.

The U. S. Fish Commission is engaged in stocking the Penobscot river with the California quinnat salmon. Last year over 2,000,000 fry were turned loose in the river while in August of this year 35,000 young about two inches in length were put into the water, while 20,000 more are to be liberated soon. It will be some time before the results of these attempts can be ascertained, but even moderate success would fully repay all the outlay.

Henry Holt & Co. have recently published *The Elements of Comparative Zoology* by Prof. J. Sterling Kingsley of Tufts College. While containing the usual text-book information, it is more than usually full of laboratory illustration, and makes a special feature of suggestive questions under "Comparisons." The same house has issued, *Laboratory Directions in General Biology* by Harriet Randolph, instructor in Bryn Mawr College.

The Plant World, a new illustrated monthly botanical journal, is announced, to be published by Willard N. Clute & Co., Binghamton,

N. Y. at one dollar a year. It will be under the editorial charge of Dr. F. H. Knowlton, of Washington, assisted by six well-known botanists. It aims to fill a position intermediate between the technical and the amateur journals.

The Association of German Naturalists and Physicians met this year on September 20th to 25th at Brunswick. Among the more important papers read was one by Professor Waldeyer upon Impregnation and Heredity, the publication of which in full will be awaited with interest. The Deutsche Botanische Gesellschaft met at the same time and place.

The University of Minnesota has maintained a summer school this season for the sixth time with a good attendance, 14 took the work in entomology ; 38 that in geology ; 18 that in animal physiology and 12 that in vegetable physiology. Courses were also given in chemistry and physics, as well as several non-scientific subjects.

The annual report of the Essex Institute has just been issued. From it we learn that the annual income was $7,400, the membership 904 and the addition to the library,which now contains about 70,000 bound volumes and 200,000 pamphlets, amounted to over 9,000 entries.

The American Museum of Natural History in New York has just received two large collections of butterflies. That of Mr. William Schaus contained over 10,000 tropical species; that of Dr. E. A. Hoffman is said to be complete in North American species.

Professor Albert von Kölliker has recently received the gold medal of the Leopold-Carolina Academy. We have previously referred to the memorials presented him upon the completion of his eighthieth year and the fifty year jubilee of his professorship.

The rules of the civil service of England have been set aside in the case of Dr. Henry Woodward who retains his position of keeper of the department of geology in the British Museum two years longer than the regulations otherwise would allow.

The University of Lyons has appropriated Fr. 42,000 for the completion of the biological laboratory at Tamaris, near Toulon, and will probably contribute annually to its maintenance.

We learn that there were hardly 400 in attendance upon the meeting of the French Academy of Science held this year at St. Etienne.

Dr. Bradley M. Davis of the University of Chicago will spend the coming year in Europe.

A slightly cracked egg of the great auk has just been sold in London for £168.

The American Naturalist.

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VOL. XXXI. December, 1897. 138

TRITUBERCULY: A REVIEW DEDICATED TO THE LATE PROFESSOR COPE.

BY HENRY FAIRFIELD OSBORN,
COLUMBIA UNIVERSITY.

The morphology of the crowns of the mammalian teeth has sprung up practically as a new branch of study since Edward D. Cope and other paleontologists have demonstrated the unity of derivation of all the complex forms from the tritubercular type. The older works and ideas of Cuvier, Owen, Huxley and others are of comparatively little service now, for they treat the teeth of each order of mammals as of so many distinct types, whereas they must now be treated as modifications of one type. This new odontography of the mammalia may be dated from the time when it was recognized that the crowns of the teeth of the Unguiculata and Ungulata, in the comprehensive Linnæan sense, are based upon a common type and are composed of homologous elements of similar origin, as developed by Cope, Osborn, Scott, Schlosser and others. It dates also from the new embryology of the teeth as studied by Leche, Kükenthal, Taeker, Röse, Woodward and others, with the revelations as to primitive form, number, and milk succession.

But to fully establish the morphological branch in its new era we must first demonstrate the theory of a tritubercular archetype. This has been opposed in one form or other by nearly all English morphologists, namely: Lankester, Forsyth-Major, Newton Parker, M. A. Woodward, E. S. Goodrich, Marion Tims. It has been accepted only by Flower and Lydekker. In Germany it has been accepted by v. Zittel, Schlosser and Rütimeyer; Schlosser, especially, has made important contributions to the evidence. The theory is accepted somewhat reservedly by the embryologists Röse, Leche, Taeker and others, who have attacked rather the homologies of the upper and lower cusps than the theory itself. In France it appears to have made little headway. In America, Scott, Allen, Wortman, Earle and many others are working upon the tritubercular theory and have made important additions to it. It is difficult for the writer to take the "primitive polybuny" hypothesis seriously, although it is advocated more or less positively by such able morphologists as Forsyth-Major, Lankester, Goodrich and Parker. The fact that the Multituberculates and Monotremes and certain Rodents exhibiting this type are primitive is no evidence that the polybunic type itself is primitive. We know nothing of the history of the degenerate Monotreme teeth, but we know that the further we go back among the ancestors of the Multituberculates and Rodents the less "polybunic" and more tritubercular they appear.

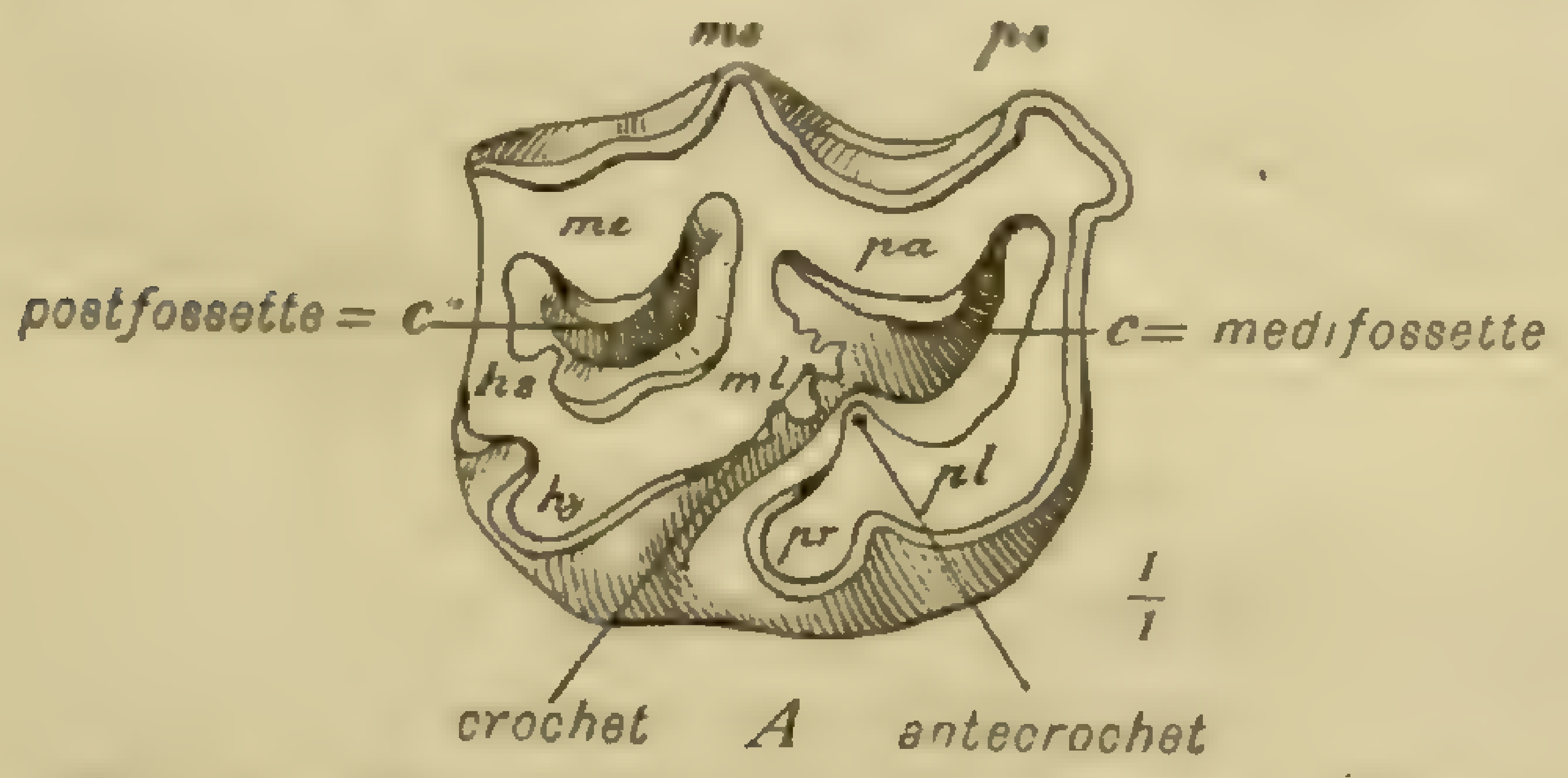

Fig. 1.—Horse Molar, *Merychippus*, Showing secondary folds.

This demonstration once made, as a matter of convenience in thought and description, we must revise the old systems of nomenclature which were based upon secondary forms rather than upon primary homologies, and which, as a rule, differ in every type of mammals and among odontologists of every land and establish a new odontography or descriptive method. Finally, we must trace out all the lines of divergence in both forms and determine the principles which guide them. The importance of a uniform nomenclature is seen at once in the

	Molar teeth of all the Mammalia.	*For Rhinoceros Molars.*		*For Rhinoceros Molars.*	*For Ungulate Molars.*	*For Horse Molars.*
	Terminology based upon evolution from a tritubercular, ancestral molar type.	Terminology used by English authors, Boyd-Dawkins ('67) Busk (1870), Lydekker (1882), and Foote (1882).		Terminology used by Cuvier (1836) and De Blainville (1846), Gaudry (1878) Pavlow (1892).	German and Russian authors, Rütimeyer and Kowalevsky (1893)	Huxley and Lydekker (1886)
Primary Molar Cones	Protocone			Denticule interne du pr. lobe	Innenpfeiler des vorjochs	Anterior pillar
	Paracone	Second Costa		Denticule externe, pr. lobe		Anterior crescent
	Metacone	Costae (in part)		Denticule externe, sec. lobe		Posterior crescent
	Hypocone			Denticule interne, sec. lobe	Innenpfeiler des nachjochs	Posterior pillar
Premolar Cones	Deuterocone					
	Tritocone					
	Tetartocone					
Secondary Pillars or Styles	Parastyle	First Costa = Buttress			Pericones, Randgipfeln	Anterior ridge
	Mesostyle					Middle ridge
	Metastyle					Posterior ridge
	Hypostyle	Posterior collis (in part)				Posterior prominence
Secondary Crests	Ectoloph	Exterior lamina = Dorsum		= crête externe	Aussenwand	
	Protoloph	Anterior collis		Colline seconde, crête ou lobe antérieure	Vorjoch	
	Metaloph	Median collis		La troisiéme colline crête ou lobe postérieure	Nachjoch	
Valleys	Praesinus	Anterior Valley		Vallon oblique		
	Postsinus	Posterior Valley		Fossette postérieure		
Secondary Folds	Crochet	Posterior combing plate	Uncus			
			Crochet	Crochet		
	Antecrochet	Anterior combing plate	Antecrochet	Crochet antérieur		
	Crista		Crista	Ante-(crochet)		
Secondary Cavities	Prae, Medi, and Postfossettes			Fossettes Fossette postérieure		Cement Lakes
Cingulum	Cingulum	Posterior collis (in part) = cingulum, guard		Bourrelet	Wulst	

accompanying table of terms used among the rhinoceroses and horses alone.

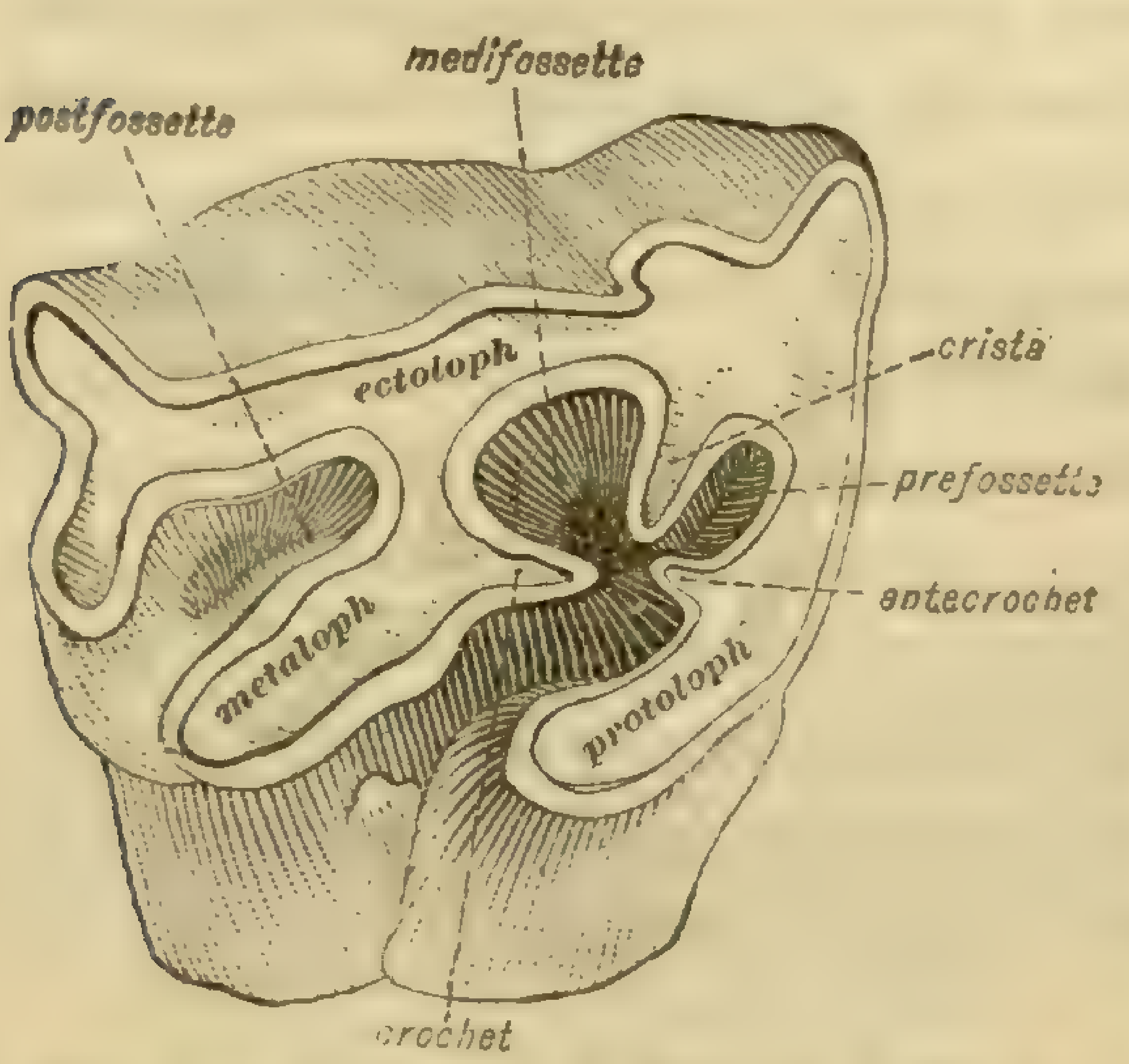
medifossette
postfossette
ectoloph
crista
prefossette
antecrochet
metaloph
protoloph
crochet

Fig. 2.—Rhinoceros Molar. Undetermined species, showing secondary folds.

It could not have been anticipated that the diverse molars of the horse and of the rhinoceros, for example, would be limited in their variations, in a late geological period, by their unity of origin in an extremely early geological period. Yet such is undoubtedly the case. Compare the accompanying figures of *Merychippus* and of *Aceratherium*. Imagine that you see the simple bunodont molar of such a form as Owen's *Hyracotherium vulpiceps*, underlying these diverse crests and crescents. Consult Taeker's "Zur Kenntniss der Odontogenese bei Ungulaten" and you will find that this sexitubercular archetype is not imaginary, but is a constantly recurring fact of embryonic development—all the crests and crescents being preceded in the embryo by simple cones.

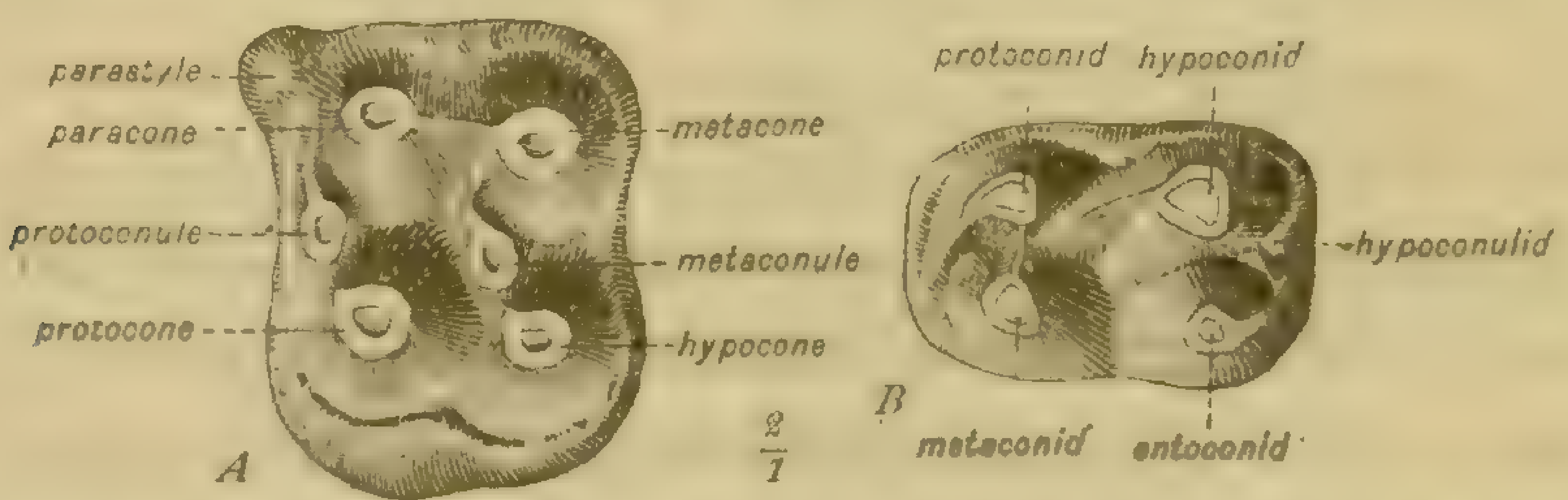
parastyle
paracone
protoconule
protocone
metacone
metaconule
hypocone
A
2/1
protoconid
hypoconid
hypoconulid
B
metaconid
entoconid

Fig. 3.—Simple Bunodont Molar.—*Hyracotherium vulpiceps*, after Owen.

Then compare carefully the variations in the two teeth as follows: The two "cement lakes" of *Merychippus* with the two "fossettes" of *Aceratherium*, enclosed in the former by crescentic spurs, and in the latter by the "antecrochet" and "crochet;" the posterior "lake" and "fossette" similarly enclosed by an upgrowth of the posterior basal cingulum. Can any one question the homologies between these secondary adaptations to a diet of grasses when it is seen that they spring from the same primary cusp centres? In the lower Eocene the sexitubercular prototype passes directly back into the tritubercular archetype. So throughout the whole mammalian scale not only ungulates, but primates, carnivores, insectivores, rodents are found playing similar variations upon the primitive tritubercular type. There are surprisingly few distinct types, but an almost unlimited number of sub-types, or variations of form. As we descend among the older rocks and the various series begin to converge, it becomes increasingly difficult to distinguish the different orders by their teeth alone. Thus it came about that all the Eocene monkeys were at first referred to the ungulates, or to transition groups, as expressed in M. Filhol's composite term *Pachy-lémuriens*.

TRITUBERCULAR HOMOLOGIES.

Embryological Evidence.—The progress which has been made in the embryology of the teeth is largely in the matter of the succession of double series, as indicated by vestiges of earlier and later sets of teeth, the so-called milk and permanent sets. Embryogenesis, however, has also led to a very minute study of the order of succession of the cones in the molar teeth, and without entering into the matter in detail, it may be briefly stated that all authors are unanimous in describing the cones of the lower molar teeth in different groups as developing in the same order in which they are supposed to have arisen in the past, according to the tritubercular theory, namely: Protoconid, Paraconid, Metaconid, Hypoconid. In the upper teeth, on the other hand, embryogenesis has been found to contradict the conclusions reached by the tritubercular theory or palingenesis, for all authors have agreed that the order is Paracone, Metacone, Protocone, instead of Protocone, Paracone, Metacone. When these facts were first brought out by Taeker, Röse and others, the writer, with undiminished confidence in the force of palæontological evidence, advanced as an explanation the fact that the protocone had become secondarily reduced in the upper molars, and that the embryogeny no longer recapitulated the order of evolution. This explanation has received a measure of support in the latest researches by

Woodward, in which it is shown that in those Insectivora *in which the protocone is still the most prominent cusp of the superior molars, this cusp also appears first in embryogeny,* the paracone and metacone following. Woodward points out that this is not the case in other Insectivora, for they agree with the Primates, Ungulates and other types which have been carefully investigated, in the late appearance of the protocone. Woodward infers from these conflicting facts that there were two modes of cusp evolution within the order Insectivora, one in which the protocone appeared first, and another in which the protocone appeared third or last. Such a double genesis seems to the writer highly improbable.

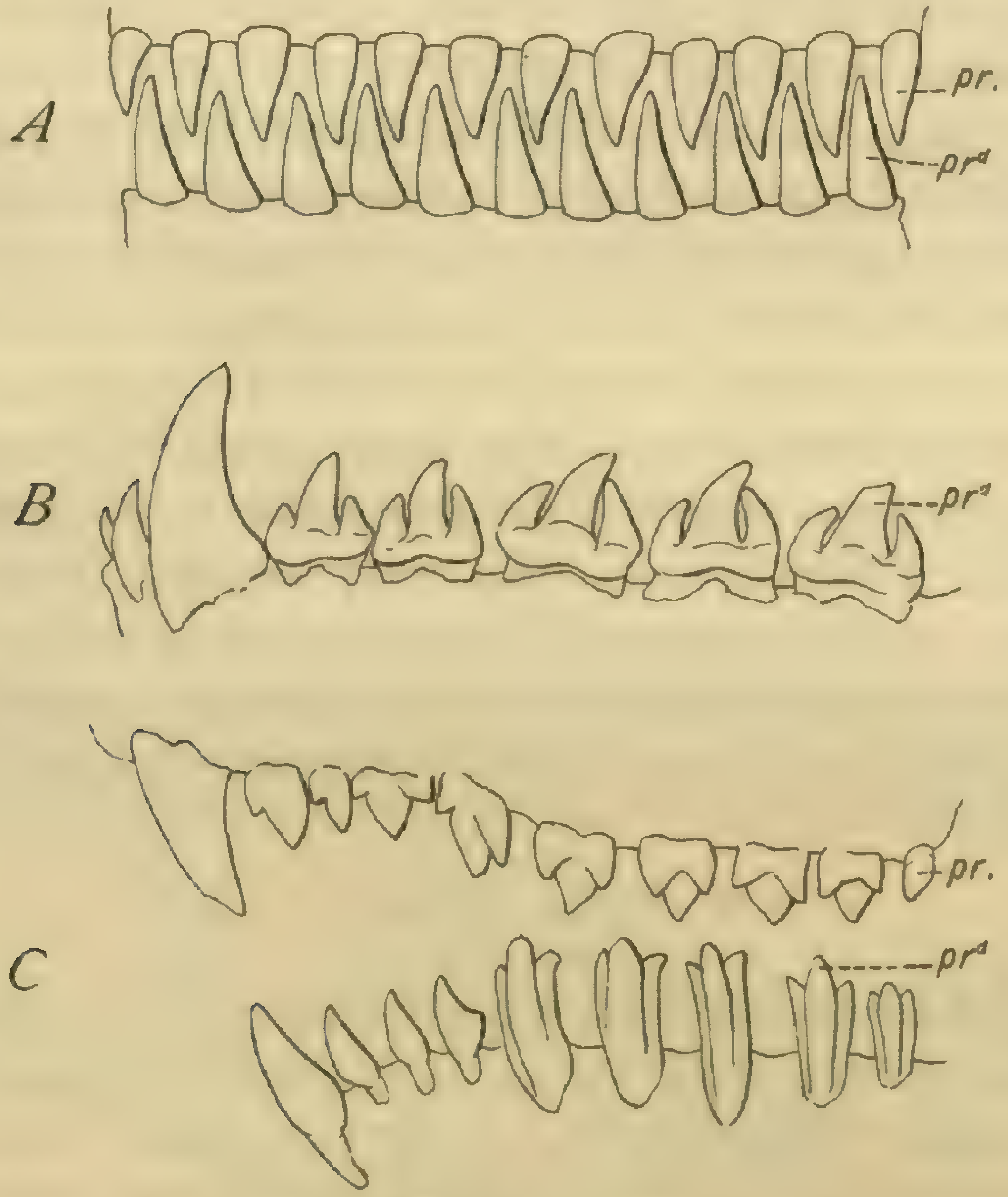

Fig. 4.—THE THREE PRIMARY FORMS.
A. Haplodont, of the Dolphin.
B. Triconodont (? Secondary) of the Seal, *Leptonyx.*
C. Tritubercular of the Cape Mole, *Chrysochloris.*

It is, however, certainly important, as Woodward and many others have observed, to strengthen the palæontological evidence for the tritubercular theory. The writer has recently made strenuous efforts to secure additional evidence, which have not thus far been successful. In the meantime too great emphasis cannot be laid upon the fact that *all the existing palæontological evidence points in the same direction*, namely, to the presence of the chief cone upon the inner side of the upper molars, and upon the outer side of the lower molars. An important oversight on the part of those who are still unconvinced of the tritubercular theory, is the necessity of a mechanical adaptation of the upper to the lower teeth in every stage of development, which is perfectly met by the tritubercular theory. Given the universally acknowledged *trigonid* or triangular arrangement of cusps in the lower teeth, no mechanical relations can be imagined in an upper molar crown which originated with the external cusps, paracone and metacone.

If the main object of palæontological research is to trace back various lines of descent as far as possible, the very unity of primitive type makes this apparently more difficult than before, but not really so. We were working before upon a false basis, or no basis at all; we can now advance upon the certain basis of primitive form and the one requisite of progress is to employ much more exact methods of description and analysis.

1. THE THREE PRIMARY FORMS.

So far as the molar teeth were concerned, there were, to our present knowledge, but three great primary forms, which succeeded each other as stages and also persisted. From one or other of these all the known recent or fossil mammalian teeth have diverged, including probably the Multituberculates. These types are illustrated in the accompanying cut. First, the *haplodont* crown, which links the mammals with the reptiles; second, the *triconodont* crown which was predominant in the Lower Jurassic period; third, the *tritubercular* crown which appeared in the Lower Cretaceous[1] and has been by far the most productive. The transitions between these great types are found among the Mesozoic mammalia and have already been worked out with considerable care.

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[1] It now appears advisable that the so-called Como (Atlantosaurus) Beds of North America and the Purbeck Beds of England should be placed in the base of the Cretaceous instead of in the Upper Jurassic as formerly.

From each of these great primary stages it would at first appear that some of the mammalia directly derived their dental type, for both the "haplodont" and "triconodont" crowns are seen to-day among the Cetacea. Yet there is ground for uncertainty here, for as the progressive stages are "haplodont," "triconodont," "tritubercular," so the retrogressive stages reverse this order, passing from "tritubercular" back to "triconodont" then into "haplodont." Another view therefore is that such primary forms have been secondarily acquired. The apparently "triconodont" lower molar of *Thylacinus* is, for example, an indirect retrogression from a tritubercular ancestral form. Again, among the aquatic carnivora, in the series of molars of the Seals, the eared Seals and the Walruses, we see the backward stages from the "triconodont" to the "haplodont;" and it is therefore probable that the "tritubercular" was the form of molar possessed by the Pinnipedia when they diverged from the Fissipedia. There is considerable evidence that a similar retrogression has simplified the molar crowns of modern Edentates, for it is now certain that at least the Gravigrada were descended from tritubercular ancestors, the Ganodonta. Again, among the Cetacea, all their oldest allies, such as *Zeuglodon*, are triconodont, not haplodont. With both these groups, therefore, there are therefore the possibilities of direct or of retrogressive origin of the "triconodont" molar.

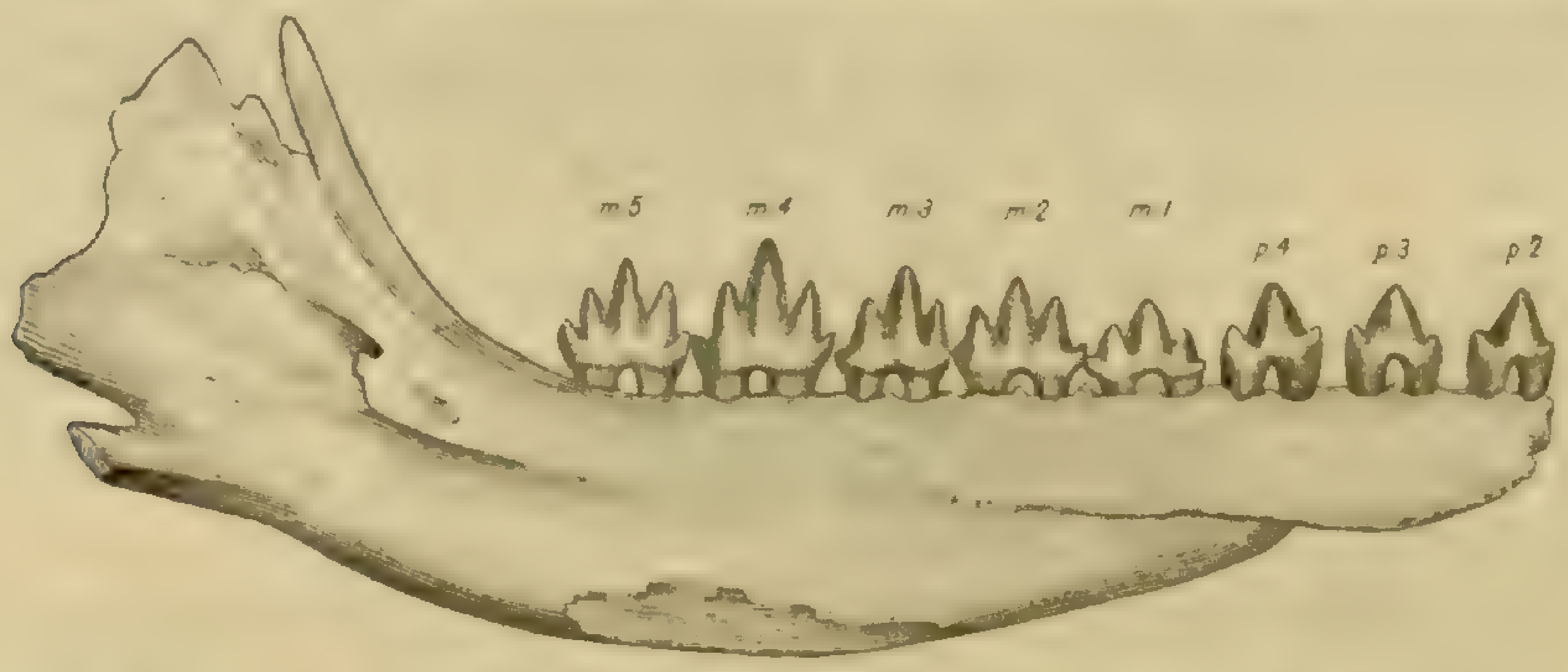


Fig. 5.—Amphilestes, a Jurassic triconodont, primary.

This uncertainty hardly extends to the "triconodont" stage, which is typically shown in the lower Jurassic *Amphilestes*, *Phascolotherium* and the later *Triconodon.* It is a very significant fact that this type dies out in the Upper Jurassic. It is true we find many more recent "triconodont" teeth, the lower molar of *Mesonyx* for example, which are positively known to be of tritubercular origin. Richard Owen compared the lower molars of *Thylacinus* with those of *Triconodon*, but we have found that what appeared to him to be similar cusps are not really homologous. Thus while it is possible that the ancestors of some of the modern haplodont and triconodont mammals never reached the tritubercular stage, it is by no means a settled fact. On the other hand, excepting the isolated group of Multituberculates and the single genus *Dicrocynodon* Marsh, *the molars of every known fossil mammal from the close of the Lower Cretaceous until the close of the Eocene period bear the tritubercular stamp.*

This would appear to support the generalization that all mammals passed through the third primary or tritubercular stage, yet it must be borne in mind that all our evidence is derived from inhabitants of fresh water basins, and that the persistent haplodont and triconodont types may have been living contemporaneously in the seas.

But the Multituberculates and Monotremes, were they tritubercular in origin? The teeth of *Ornithorhynchus* are so degenerate and irregular that many features of primitive form may be lost; they may quite as readily be interpreted as tritubercular as multitubercular, especially in the embryonic stage as described by Poulton.

It is not difficult however to establish the principle that a true multitubercular tooth may spring from a tritubercular tooth. As pointed out elsewhere, my friend, Prof. J. A. Allen, directed my attention to the "multituberculate" rodents. A comparison of *Mus*, *Dipodomys* and *Perognathus* beautifully illustrates the stages between "trituberculy" and "multituberculy" in living types. The three rows containing twelve tubercles in the later genus are derived respectively from the "external," "intermediate" and "internal" cusps of a sexitubercular bunodont type similar to the *Hyracotherium* molar on a small scale. The additional cusps are successively added to each row. Thus the upper molar of *Perognathus* is closely analogous to that of the Mesozoic Multituberculata, especially to such a type as *Tritylodon.* Passing also from the higher Multituberculata to the lower and more ancient, we find fewer and fewer cusps until we reach a "paucitubercular" parent form in the upper Triassic *Microlestes. Microlestes* itself was not tritubercular; it had a basin-shaped crown surrounded by irregular tubercles; this basin, however, was not dissimilar to that in molars of the Eocene rodent *Plesiarctomys* which is obviously of tritubercular origin.

This evidence has been recently reinforced in a most striking manner by the discoveries of Professor Seeley in the Karoo Beds of South Africa, from which two principal conclusions may be derived: First, that *Tritylodon,* formerly placed with the mammalia, contains a large number of reptilian characters. Since the fossil is closely related on the other hand to the remaining Multituberculata, it appears possible that we have in the *Gomphodontia* the group from which the Multituberculates sprang. A study of the dentition of other Theriodonts in the Karoo Beds shows that while *Tritylodon* and *Trirachodon* are typically Multituberculates, others, such as *Diademodon* have a tritubercular pattern, exactly such a pattern as we find in certain Lower Eocene mammals. Altogether there is certainly

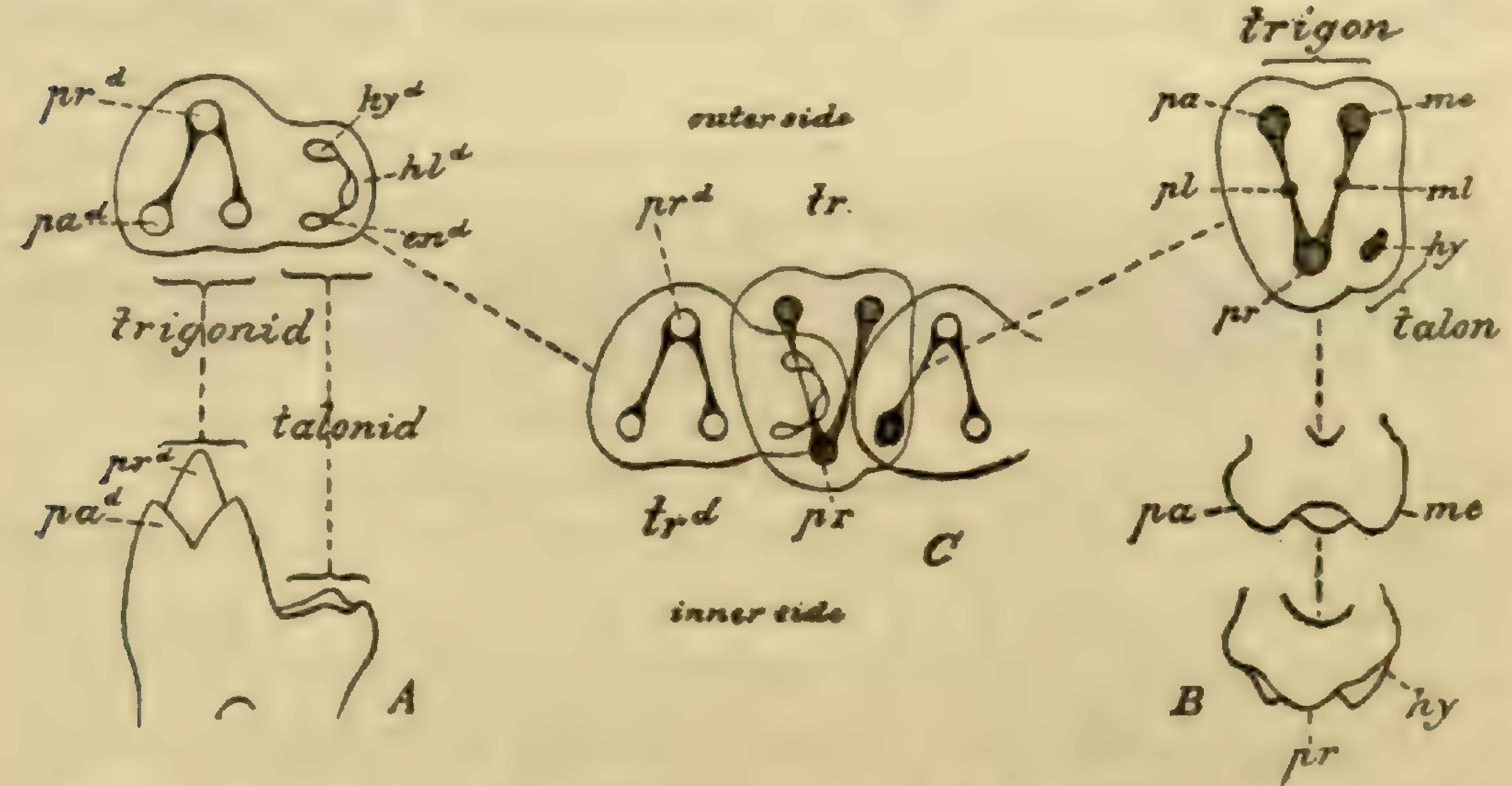


Fig. 6.—TRIGON AND TALON. Mechanical relations of tritubercular molars; also homologous and functionally analogous parts.

increasing support for the writer's hypothesis, that the multituberculate tooth is of tritubercular origin.

2. THE EARLY STAGES OF SEXITUBERCULY.

The Trigon.—Respect for Cope's priority should not prevent our ultimately adopting the late Professor Rütimeyer's term *trigonodont* for the third stage, retaining the term "tritutubercular" as descriptive of the whole transformation, and as peculiarly appropriate to certain types of teeth, such as the superior molars of the lemurs. "Trigonodont" is most appropriate because the first step in molar morphology is to identify the "primitive triangle," and the term "tubercular" hardly applies to a lofty pointed cutting crown. Our studies among the Mesozoic mammals have left no doubt that the upper and lower triangles, or "trigon" and "trigonid,"were derived from the reptilian protocone by the addition of lateral cusps. The mechanical perfection of this type consisted in the fact that the lateral cusps were developed upon or shifted to the outer side in the upper molars, and to the inner side in the lower molars, thus producing an interlocking "shear." The "trigon" was essentially a cutting apparatus, so perfect that many mammals retained it without further evoluiton. Thus *Chrysochloris*, the little Insectivore of the Cape, presents a fine example of this type, persistent in its molars. (See Figure 4).

The Talon.—But in the great majority of trituberculates the "talon" was added as a crushing apparatus. It invariably appeared first in the lower molars (where we may distinguish it as the "talonid") and pressed into the basin of the superior "trigon." At first it was a mere spur (hypocone) as in *Amphitherium* or in the existing *Calcochloris* (allied to *Chrysochloris*), but between the Jurassic and Upper Cretaceous periods the talonid widened into a basin-like shelf supporting an outer cusp, the "hypoconid;" an intermediate cusp, the "hypoconulid," and an inner cusp, the "entoconid." Thus we find in the majority the Upper Cretaceous (Laramie) and Puerco or lowest Eocene mammals that the lower molars bear six cusps; the above-mentioned three on the talonid and three on the trigonid (protoconid, paraconid, metaconid). With these six cusps the equipment of the lower molar was complete, and it was ready for transformation into the molar of a primate, ungulate or carnivore, as the case might be.

But why notice such a detail as the posterior intermediate cusp or hypoconulid? Because, to give only two reasons, this cusp plays an important rôle in the ungulates; it is invariably present, except perhaps in the Coryphodons, and forms the third lobe of the last lower molar, which is thus proved to be

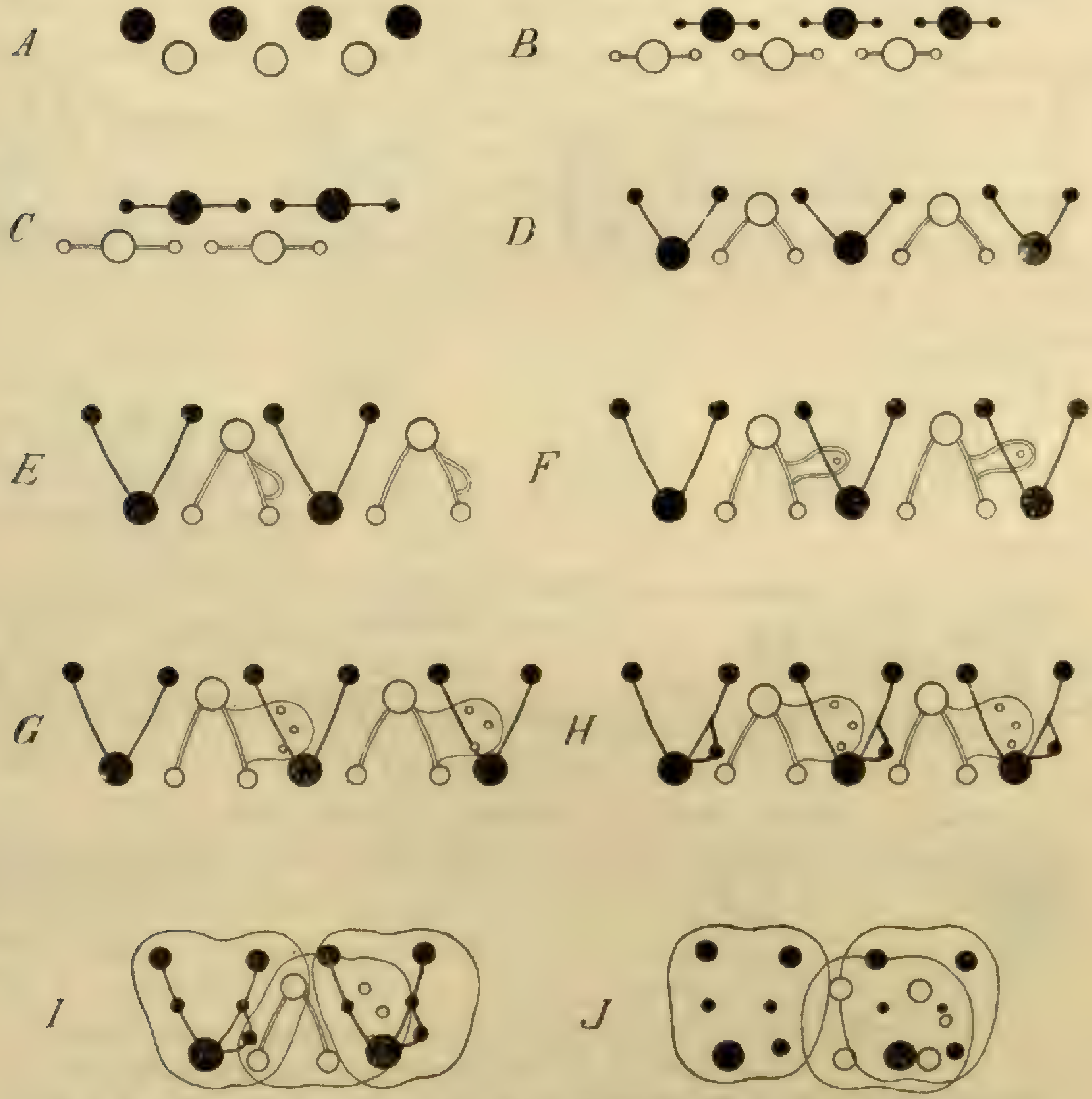
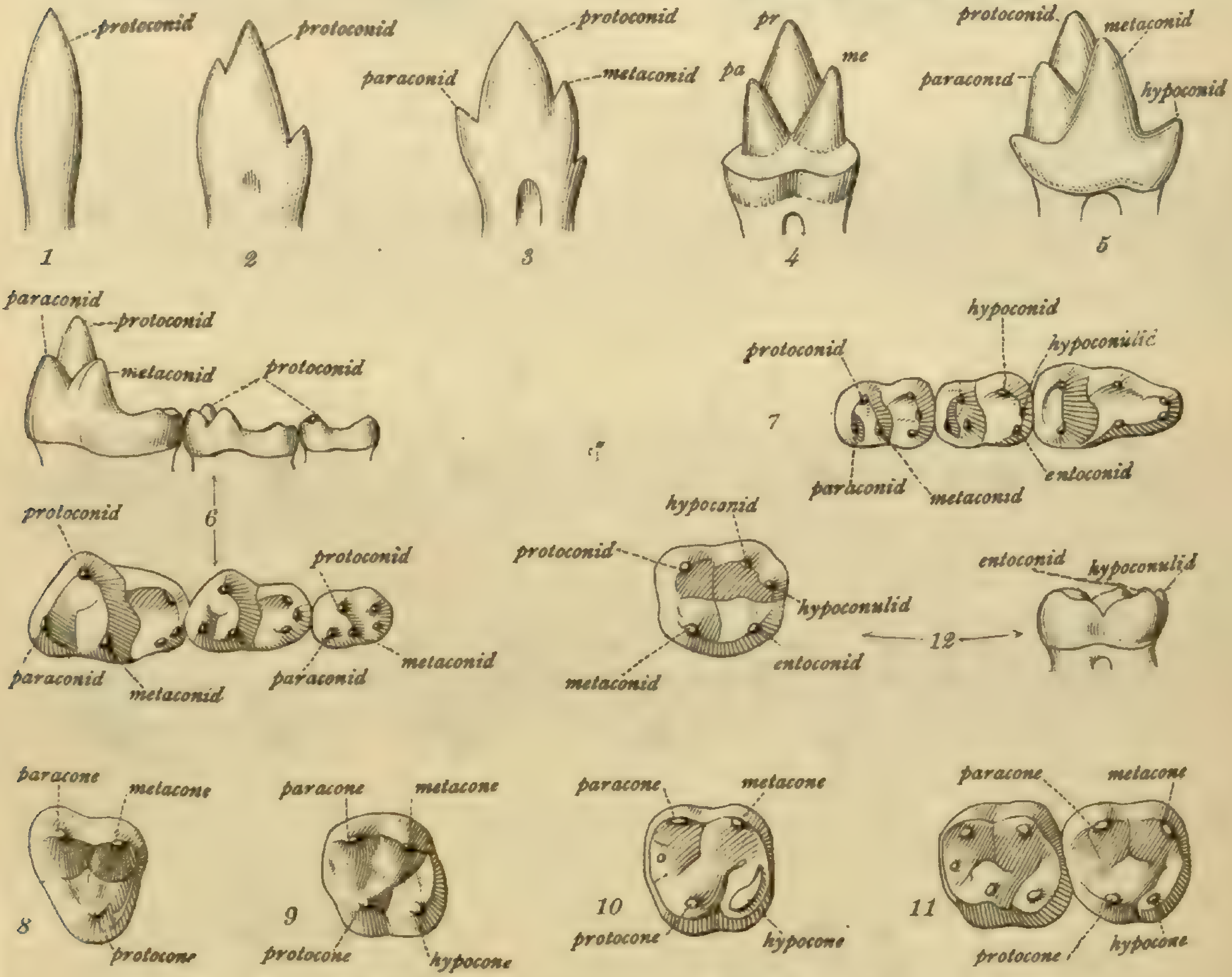


Fig. 7.—Phyletic and Mechanical History of the Molar Cusps. *A*. Reptilian stage, Haplodont, Permian. *B*. Protodont stage (*Dromatherium*) Triassic. *C*. Triconodont stage (*Amphilestes*). *D*. Tritubercular stage (*Spalacotherium*). *E*. Tritubercular-tuberculo sectorial, Lower Jurassic. *F*. The same, in Upper Jurassic. *G*. The same, in Upper Cretaceous. *H*. The same, Puerco, Lower Eocene. *I*. Sexitubercular-sexitubercular, Puerco. *J*. Sexitubercular-quadritubercular, Wahsatch.

a primitive character. Again, it is found throughout all the Primates, and although seldom availed of, this cusp constitutes an important and distinctive character as between the different races of man. Its extreme antiquity is appreciated by few anthropologists, and at the present time it is degenerating. (See Figure 8).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11
protocone
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Fig. 8.—Epitome of the Evolution of the Human Molar Teeth. 1. Reptile. 2. Dromatherium. 3. Microconodon. 4. Spalacotherium. 5. Amphitherium. 6. Miacis. 7–8. Anaptomorphus. 9–12. Various Primates 11–12. Homo. A succession of molar *types*, not of ancestral types.

While these changes were taking place, the upper molars remained comparatively stationary in the persistence of the simple trigon, up to the close of the Cretaceous period, the main change being a depression of the level of the trigon. All three cusps in some groups were depressed from the high secodont to the low bunodont level. In the majority of the carnivorous types we find that only the protocone was depressed and that the pair of outer cusps, paracone and metacone, persisted on their high primitive level; the crown being thus prepared for the transformation into the true "sectorial." But in the omnivorous and herbivorous types, all three cusps are depressed and the upper molars always increased their crushing area by the addition of a heel or "talon," exactly analogous to that previously developed upon the lower molars. As is well known, this "hypocone" is an upgrowth from the cingulum and its typical mode of development is well shown in the Primates (Fig. 9). While this was going on, the trigon was also supplementing its bunodont equipment by the addition of the little intermediate cusps "protoconule" and "metaconule." These always appeared where the "talonid" abuts against the "trigon." Thus, finally, the upper molar, like the lower, was provided with six cusps and both were ready to diverge into any ungulate form.

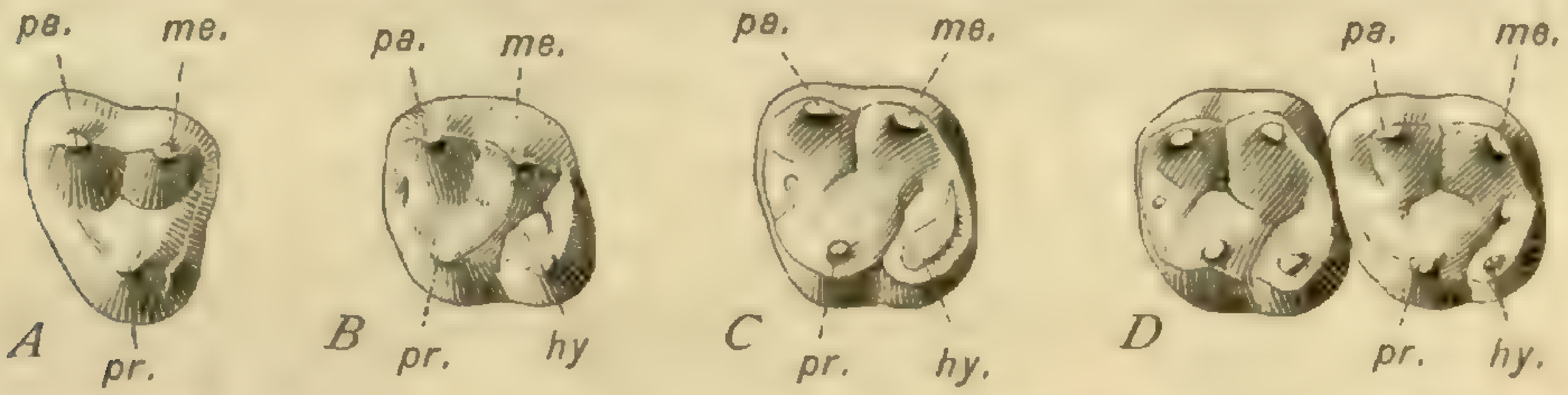


Fig. 9.—Superior molars of Primates, Anaptomorphus to Homo, showing evolution of *hypocone*, *hy*, from the cingulum.

All these foregoing stages persist and may be readily studied and verified among some of the living marsupials, insectivores, lemurs and monkeys, and can be seen in any well-equipped osteological museum almost as well as among the fossil series.

THE NOMENCLATURE OF THE MOLAR CUSPS AND CRESTS.

The system proposed by the writer some years ago has now been adopted by many of the American, English and German writers who are studying the fossil series. It is based upon simple principles:

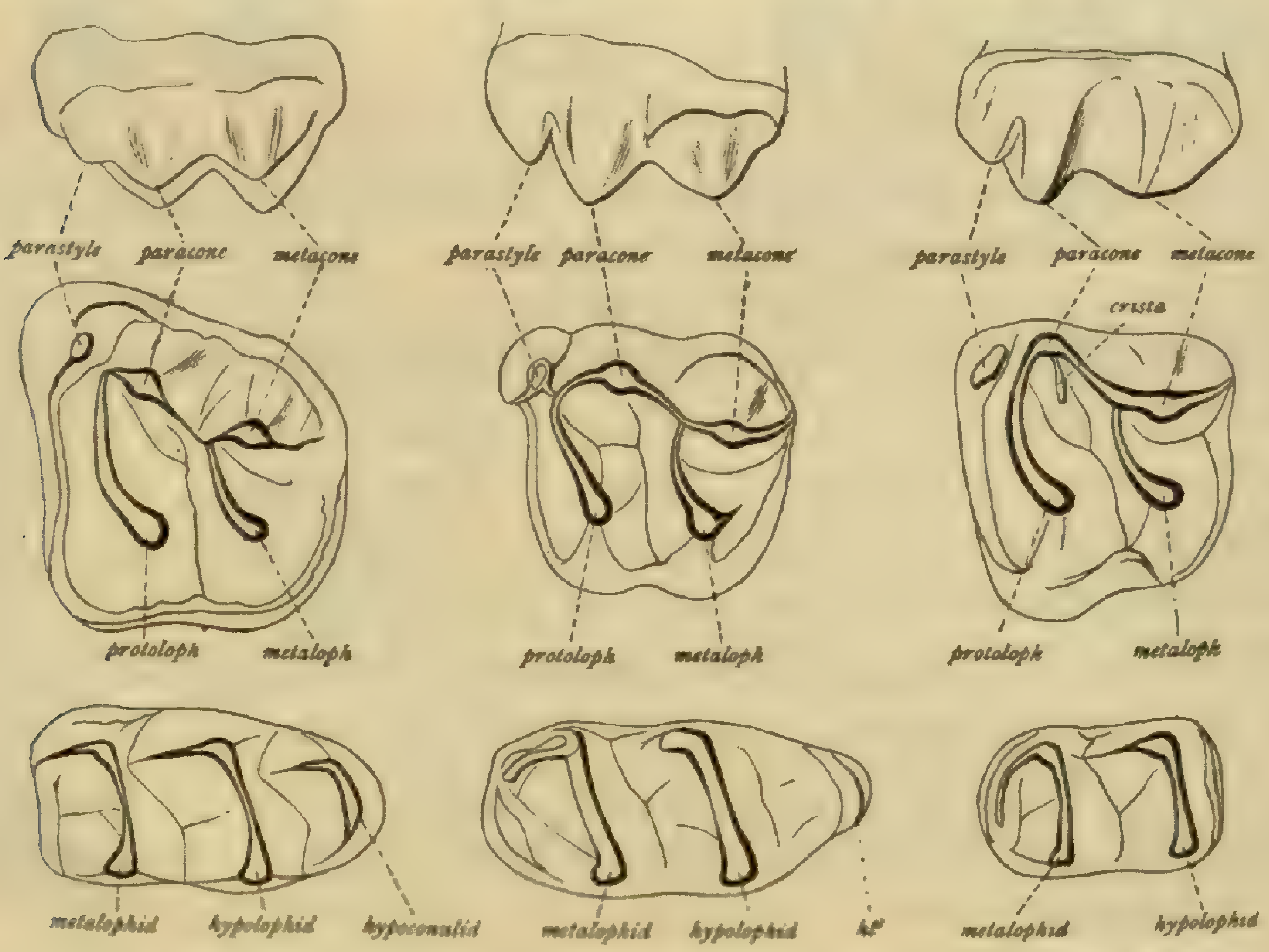
1°. The termination "*-cone*" is employed for all the primary central cusps derived from the crown of the tooth, while the diminutive *-conule* is employed for the smaller "intermediates" or cuspules.

2°. All peripheral cusps or elements developed mainly from the cingulum or external borders of the crown are distinguished as *-styles* ("pillar" or "buttress"). The only exception is the "hypocone," which, while arising from the cingulum, soon takes its place upon the crown.

3°. The crests, transverse and longitudinal, are always composed of two or more cusps and styles, and are distinguished by the termination *-loph*.

4°. The prefixes "*proto-*," "*para-*," "*meta-*," "*hypo-*," "*ento-*," etc., refer back to the primitive position or order of development in the triconodont and tritubercular stages.

5°. The suffix *-id* is employed arbitrarily to distinguish the elements of the lower molars from those of the upper.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metalophid
hypolophid
hypoconulid
metalophid
hypolophid
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metalophid
hypolophid

Tapir Type.

Lophiodon Type.

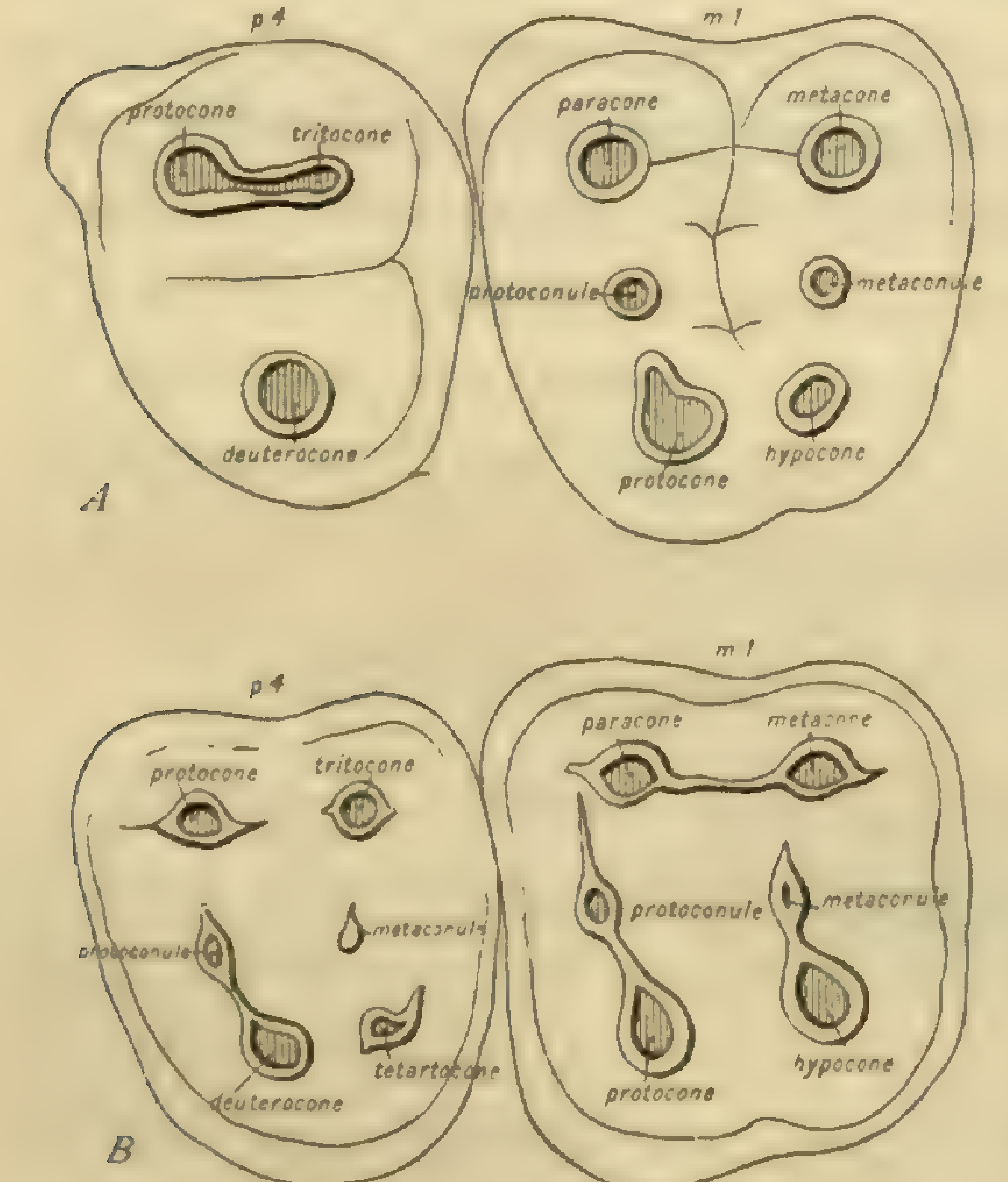
Rhinoceros Type.

Fig. 10.—Modelling of the Cusps.

The use of the terms "trigon" and "talon" for the cutting and crushing regions of the crown, respectively, is especially advantageous among the the upper Mesozoic and lower Cainozoic mammals, where it is necessary to refer constantly to the relations of the upper and lower crowns in apposition, as in the evolution of the sectorial and lophodont types. As to the form of the cusps, we pass from simple pointed cusps to three well known modes of modification to which the adjective "bunoid," "lophoid," and "selenoid" may be applied. A combination of these terms gives us a permanent system of distinguishing the complex forms of ungulate molars from each other, by referring first to the form of the protocone; second, to that of the outer paracone and metacone. Thus in *Palæosyops*, as the protocone is bunoid and the outer cusps are selenoid, the crown may be distinguished as "buno-selenodont." In *Palæotherium* the protocone is "lophoid," and it may be described as "lopho-selenodont." *Rhinoceros* is truly "lophodont," since all its six cusps are "lophoid." These are preferable to the terms "tapirodont," "symborodont," "bathmodont," "loxolophodont," etc., proposed by Cope, because the latter are associated with generic types.

THE EVOLUTION OF THE UNGULATE MOLAR.

The fact of derivation of all ungulate molars (excepting in the Amblypoda) from sexitubercular upper and lower crowns, leads us to look sharply for traces of these six tubercles from the primitive plan of *Euprotogonia*. These six cusps are almost invariably found in the upper molars of both perissodactyls and artiodactyls up to the middle of the Eocene period, as typified in *Hyracotherium* and *Homacodon* or *Dichobune*. In the lower molar the trigon loses the "paraconid" and the talon loses the "hypoconulid," the latter persisting only in the last molar as the "third lobe." This loss was accompanied by the complete transformation of the lower molars from the "secodont" to the comparative "bunodont" type, as effected in the lowering of the "trigonid" to the level of the "talonid." This is exemplified in the steps between the first and third molars of the creodont genus *Miacis* (Fig. 8). In a side view of all early ungulate molars, such as *Hyracotherium*, we see that the "trigonid" is still the highest portion of the crown. In the ungulates, unlike the carnivores, all three molars were affected simultaneously. An exactly similar levelling process can now be observed in a comparative series of recent Lemurs and Monkeys. To summarize the five steps toward the establishment of the ungulate primitive type: the addition of the lower talonid, the lowering of the cusps of the upper trigon, the addition of the upper talon and simultaneous lowering of the lower trigonid, the loss of the paraconid and hypoconulid. By these changes the cutting was transformed into the crushing type. The development of the talon necessitated the loss of the "paraconid," for they both occupy the same space when the jaws are closed; the stages of this gain to the upper molar and loss to the lower are well shown in the species of *Euprotogonia.*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metacone
protoconule
metaconule
protoconule
metaconule
tetartocone
deuterocone
protocone
hypocone
B

Fig. 11.—Premolar Terminology, proposed by Scott. Primitive Ungulate Types. Fourth upper premolar and first molar of *A. Euprotogonia,* and *B. Hyracotherium.*

All these changes belonged to the constructive period and took place presumably before the great divergence of the ungulate orders began; or it may have been partly due to paralellism or homoplasy, because we find that the molars of *Trigonolestes,* the earliest known artiodactyl, are tritubercular. Some groups, such as those to which *Coryphodon, Uintatherium* and *Periptychus* belong, built up their whole molar structure upon the tritubercular or trigonal basis.

From this point onward dated the period of "modernization." An important legacy of the old triangular form was the *oblique arrangement of the outer and inner cusps* parallel with the sides of the primitive triangles. Thus all the primitive crests developed upon these cusps were oblique and not directly transverse. The main features of modernization upon which we must now closely direct attention are:

1°. The addition of one or more peripheral cusps or "styles" as upgrowths from the cingulum. These reached their most extreme development in the *Equidæ.* (See Fig. 10.)

2°. The persistence or degeneration of the cingulum at certain points, for all primitive molars are completely invested by a broad cingulum.

3°. The modelling of the cusps into the "bunoid," "lophoid" or "selenoid" form.

4°. The metatrophic or unequal growth of the cusps, especially as affecting the external pair, protocone and metacone, in the upper molars.

5°. The shifting of the cusps from their primitive position upon the crowns.

6°. The shifting point of union of these transverse crests with the external crest.

The differential features of the development of ungulate molars all group around these six heads. If we were examining an isolated molar tooth from the lower Eocene, the first step would be to locate its primary cusps and then note its divergence as tested by the above differentia. We would then be in a position to make a conjecture as to the series in which this molar belonged—as no two series are modified similarly in all these respects. Yet the prevailing method among many palæontologists is to pass lightly over most of the differentia and, for example, group widely divergent forms under the *Lophiodontidæ* as if in the constitution of these dense enamelled tissues nature could lightly pass from one to another.

A few words now upon the secondary "styles." Their function is evidently to increase and elaborate the crushing surface of the crown. In *Phenacodus* the first to appear is the "mesostyle" between the paracone and metacone, but this genus was on a side line of the *Condylarthra.* In all true perissodactyls and artiodactyls, the first peripheral cusp to appear is the antero-external buttress of the upper molars, which we call the "parastyle," since it adjoins the paracone. The "mesostyle" appears later, and only in those ungulates in which the paracone and metacone are moulded into crescents. Thus the lower Eocene *Hyracotherium* does not exhibit this cusp, but it appears as a distinctive feature of the middle and upper Eocene *Pachynolophus* (Orohippus). The mesostyle was strongly developed in all the selenodont, buno-selenodont and lopho-selenodont types, such as the Artiodactyla and *Meniscotherium*, *Chalicotherium*, *Palæosyops*, the palæotheres and horses. Look at an upper molar of *Merychippus* and see what an important rôle these styles play (Fig. 1). First, we observe the "parastyle" and "mesostyle," next most important is the "hypostyle," which develops near the hypocone upon the posterior cingulum of *Mesohippus* and *Anchitherium* and finally completes the border of the "anterior fossette" or cement lake. The horse molar, by the way, furnishes the best illustration of the value of tracing back the various portions of the crown to their birth-place in the primitive crown of *Hyracotherium*. Every turn in this labyrinth of folds is thus made perfectly clear.[1]

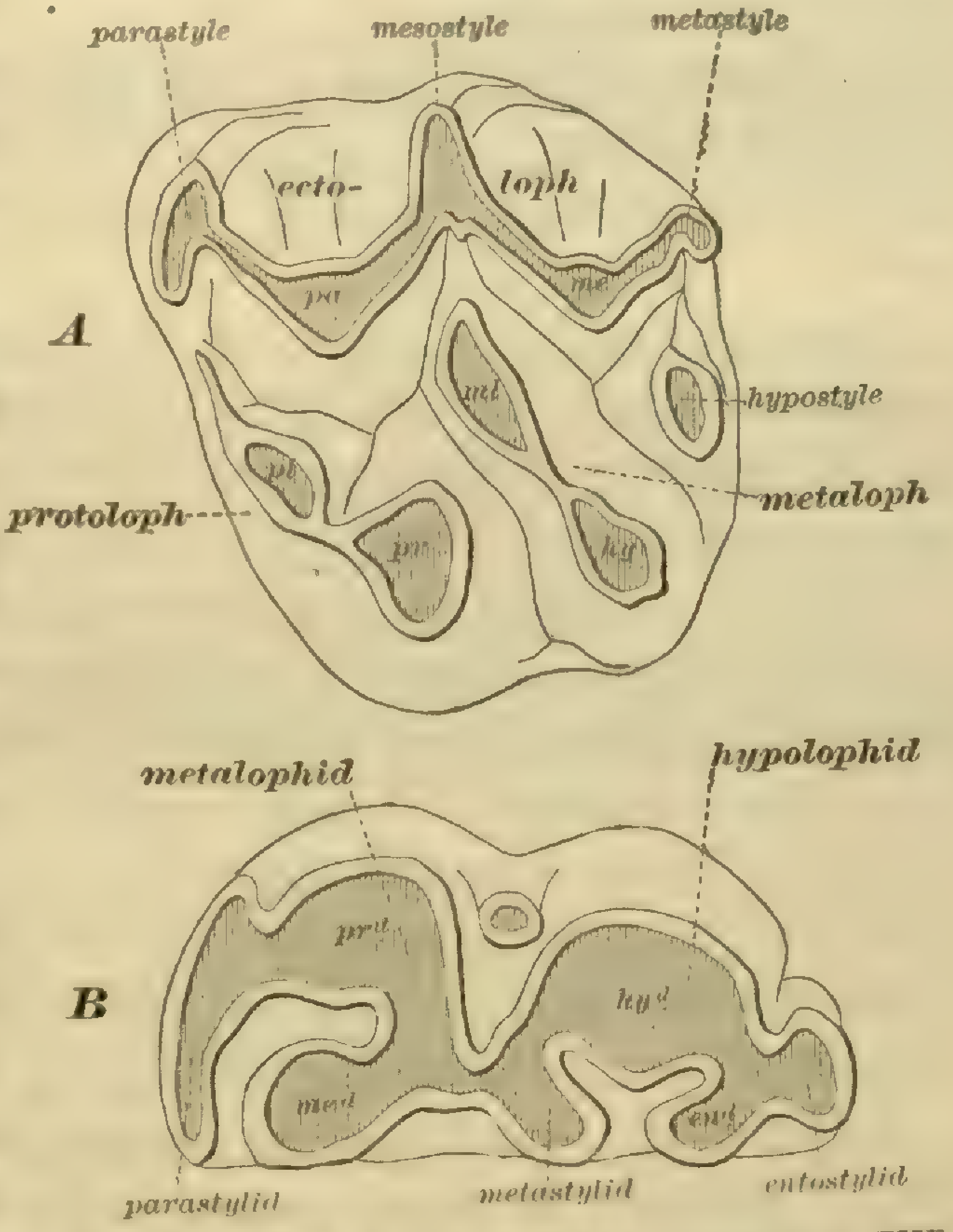
parastyle
mesostyle
metastyle
ecto-
loph
pa
me
A
ml
hypostyle
pl
metaloph
protoloph
pr
hy
metalophid
hypolophid
prd
B
hyd
med
end
parastylid
metastylid
entostylid

Fig. 12.—The Highest Development of the Styles. *A*. Upper molar of Horses, *Anchitherium* and *B*. *Merychippus*.

A corresponding set of styles grows up on the lower molars, and it is very easy to locate them with reference to the reciprocal upper set if we simply keep in mind the fact that throughout the whole course of development the elements of each trigonid are placed just in front of those of the corresponding trigon, that is, the protoconid and metaconid fit just in front of the paracone and protocone, as shown in the diagram (Fig. 6). Thus the inferior entostylid is developed near the entoconid, while the superior hypostyle develops near the hypocone. The first of the inferior styles to develop is the "metastyle," a reduplication of the metacone, the well known "a-a" of Rütimeyer.

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[1] Mr. Lydekker has courteously called attention to the fact that in the earlier study of this subject the writer misinterpreted the descriptive terms employed by Huxley.

In all ungulates in which the "mesostyle" is developed the external cusps remain of the same size. In the tapirs no "mesostyle" appears, yet these cusps are symmetrical; but in the rhinoceroses, which also lack the mesostyle, the first fact to note is the asymmetrical growth of these cusps; the metacone is elongated while the paracone is reduced and crowded up against the parastyle. This point was observed by Cope in seeking for a definition of the Rhinocerotidæ in 1875. The rhinocerotine molar, whether of *Hyrachyus, Amonodon* or *Aceratherium*, has the further distinction that it is the only type in which a complete ectoloph is formed, and second, as Cope has already observed, the asymmetry of the external cusps is emphasized by the flattened metacone and conic paracone. Figure 2 illustrates also the three projections from the ectoloph, protoloph and metaloph, namely, the "crista," "antecrochet" and "crochet." These, with the three "fossettes" formed by them, were noted and named by Cuvier, and, as shown by Falconer, Flower, Lydekker and others, are of great specific value.[2] We have already seen that Cuvier's term "fossette" may be substituted for the "cement lakes" in the horse's molar. The terms formerly adopted, or proposed, by Lydekker[3], after English usage, and those in German and French usage, have already been given in the Table

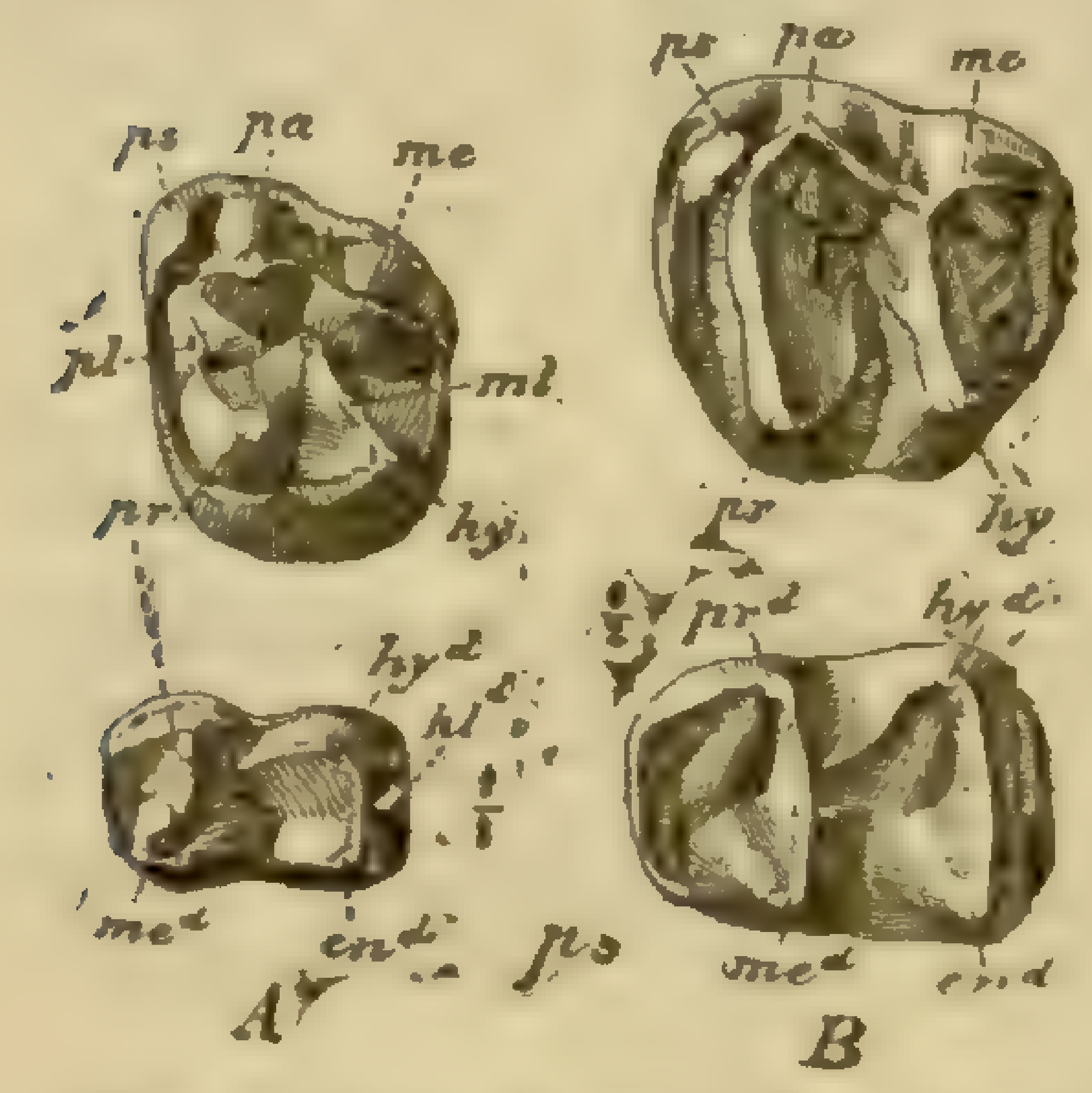

Fig. 13.—TAPIR MOLARS. Primitive *Systemodon*, and modern *Tapirus*.

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[2] As pointed out by Lydekker, the writer mistakenly transposed these terms "crochet" and "antecrochet" in a former paper, Bull. Mus. Comp. Zool., 1890, p. 81.

[3] "Siwalik Rhinocerotidæ," Pal. Indica.

There is another line of perissodactyls in which the metacone is flattened but not elongated, and no complete ectoloph is formed. I refer to the little Wasatch genus *Heptodon* (which Cope has erroneously placed in the ancestry of *Hyrachyus*), also *Helaletes* of the Bridger, an undoubted successor of *Heptodon,* which Marsh was wrongly led to consider an ancestor of the Tapirs. The molars, studied by our six differentia, are found to differ from those of the rhinocerotine *Hyrachyus* by the incomplete ectoloph, also by the shifting inwards of the metacone and consequent shortening of the metaloph. In looking about for molars with similar differentia, we find those of the true *Lophiodon* of Europe, *L. isselense,* for example, stand nearest.

Now, how shall we distinguish the early Tapirs? First, there is no mesostyle; second, the paracone and metacone (as observed by Cope) are both conic and symmetrical; third, a feature of great importance, apparently unnoticed hitherto, is that the protoloph and metaloph spring from the anterior bases of the paracone and metacone, and not from near the apices of these external cusps as in all molars of rhinocerotine affinity. We find, as a general law, that where the external cusps are symmetrical as in Palæotheres, Horses and Tapirs, the transverse crests always arise in front; where they tend to asymmetry as in Helaletes, Lophiodon and Rhinoceros, the crests tend to rise from or near the apices.

Enough has been said to make clear the new method of procedure in the analysis and discrimination of early ungulate molars. Let us apply this form of statement and description to the aberrant lower Wasatch genus *Meniscotherium* as a resumé:

Upper Molars, buno-selenodont; paracone, metacone and protoconule selenoid; metaconule reduced, lophoid, united with hypocone; a large parastyle and mesostyle. *Lower Molars,* seleno-lophodont; metaconid reduplicated by metastylid. We find that a similar analysis may be given of *Chalicotherium,* excepting only "protoconule reduced." It is thus suggested that *Meniscotherium* may be related to *Chalicotherium.*

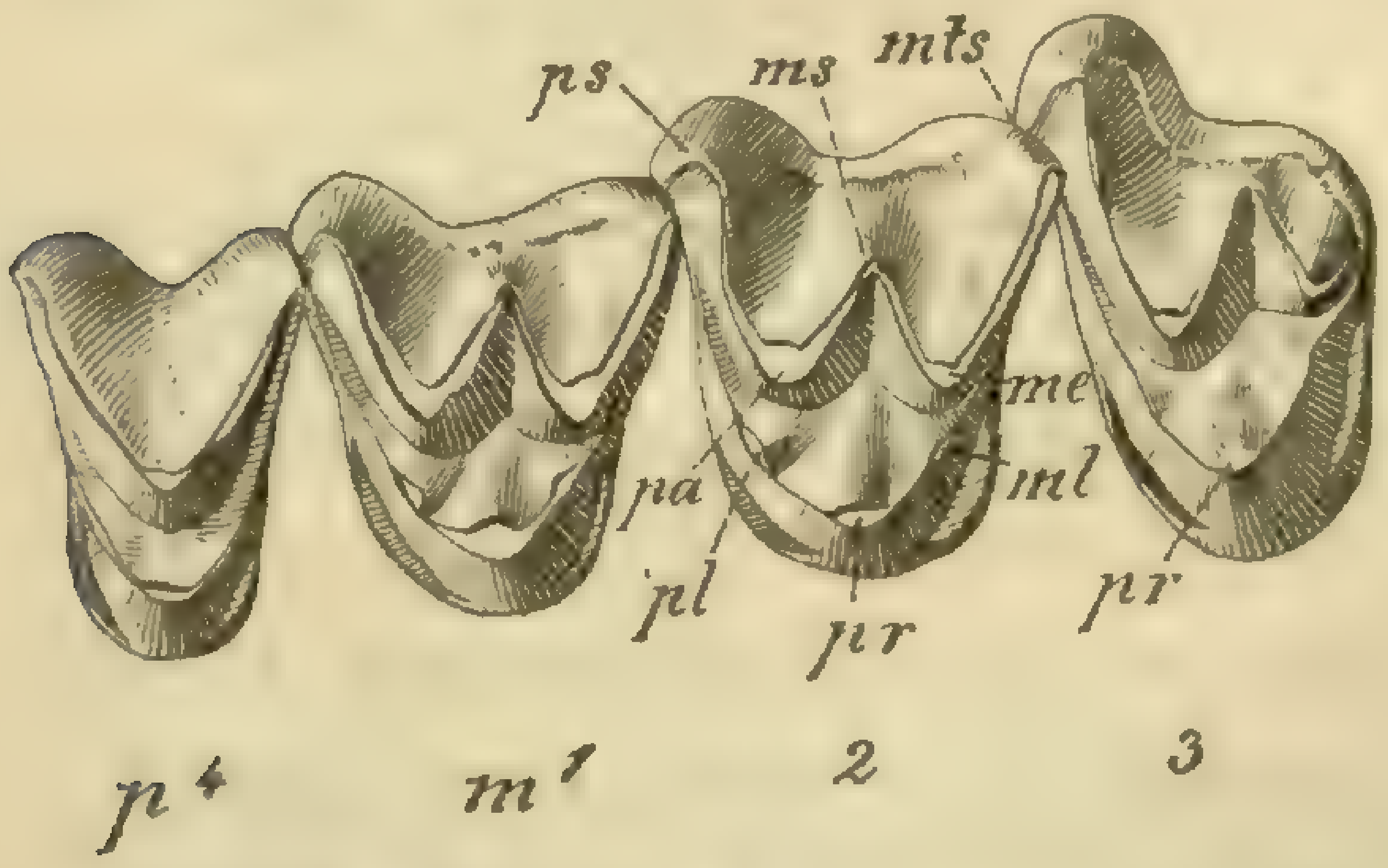
ps
ms
mts
me
ml
pa
pl
pr
pr
p 4
m 1
2
3

Fig. 14.—Molars of *Pantolambda*, the ancestor of *Coryphodon*.

This method may be summarized as follows: Look for traces of *primitive* ancestral structure in the form and position of the cusps. Second, determine the divergent form, position, proportions and relations of the cusps. Third, determine the secondary cusps, crests and foldings, their form and relations. Finally, let us turn to a wholly different molar type and examine the complex and aberrant molars of *Coryphodon*. Can we establish any homologies between its elements and those of any of the ungulates we have been considering? Fortunately we are partly guided by the molar of the Puerco genus *Pantolambda* Cope, which is even older than the Coryphodons. This is our key to the ancestral or primitive form, and by its aid Cope has, we think, rightly interpreted the homologies of the Coryphodon molar elements. We first note that nature has here evolved a lophodont crown from the tritubercular or trigonal basis, for there is no distinct talon or hypocone except in the unique form *Manteodon*. *Pantolambda* has no parastyle, but a prominent mesostyle and a pair of selenoid external cusps, also a selenoid protocone with a spur leading toward a proto-

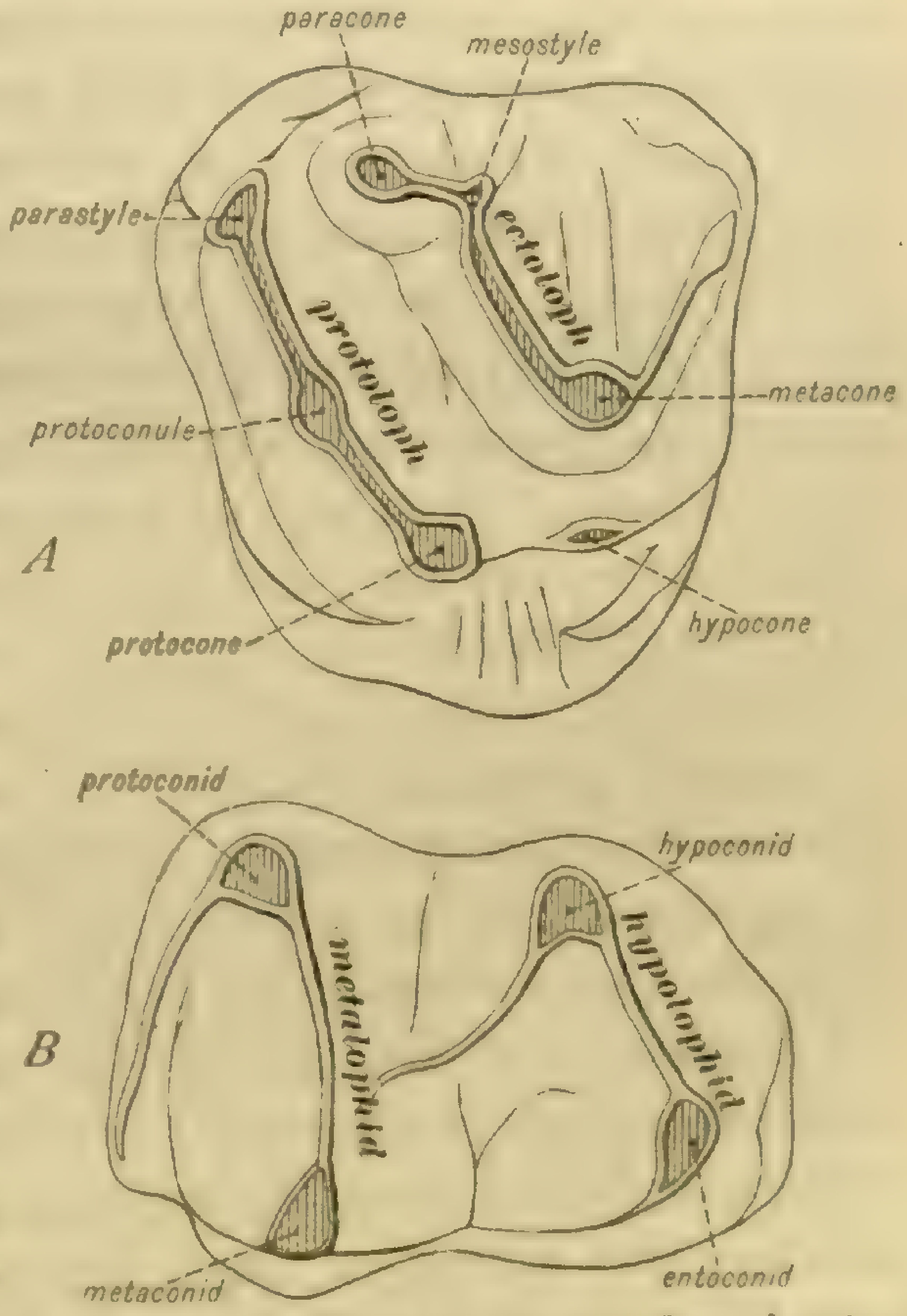
paracone
mesostyle
parastyle
ectoloph
protoloph
metacone
protoconule
A
protocone
hypocone
protoconid
hypoconid
metalophid
hypolophid
B
metaconid
entoconid

Fig. 15.—Molars of *Coryphodon*, showing shifting of the Crests.

conule and suggesting an incipient protoloph. The selenoid external cusps of this type suggest a comparison with the lopho-selenodont perissodactyls, and we are able to reach the following result.

In a large series of *Coryphodon* molars we see first that the protoloph is formed of the protocone, protoconule and parastyle, exactly as in the horses. Unlike the horse (Anchitherium), the ectoloph is more or less detached from the protoloph, but the examination of a large series of specimens in the American Museum and Cope's collection convince us that it is composed of the same elements as in *Anchitherium*, namely, the paracone, which has almost lost its crescentic form, the mesostyle, which is much less prominent, and the metacone, which is still crescentic. This enables us to describe this molar as follows: It is of buno-selenodont origin and has a complete protoloph and ectoloph, *but no metaloph*. Its homologies with the elements of the Anchitherium molar are clearly shown by a comparison of Fig. 12 and Fig. 15. This illustrates again the necessity of starting upon the trigonal basis instead of upon the basis of two lobes, as in the work of French palæontologists. In his "Enchainements du Monde Animal," Prof. Gaudry has admirably worked out the upper molars of the perissodactyla and artiodactyla from the sexitubercular stage onwards. He divides the tooth into two lobes, a "premier lobe," including our protocone, protoconule and paracone and a "second lobe" including our hypocone, metaconule and metacone. All subsequent authors in France follow this system, which indeed works well for one group. But what we need now is a system which will apply not only to all groups of ungulates, but to unguiculates as well, so that when we reach the upper Cretaceous borderland between unguiculates and ungulates we can employ the same set of terms and the same basis of description.

I can only conclude by expressing the conviction that the tritubercular theory of Cope rests upon such conclusive evidence that its universal adoption as the key to the interpretation of all molar teeth cannot be long deferred. It is one of the chief anatomical generalizations of the present century.

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BIOLOGICAL STUDIES IN MASSACHUSETTS.

NO. 3.

By GEORGE C. WHIPPLE.

GEOGRAPHICAL DISTRIBUTION OF MICROSCOPICAL ORGANISMS.

The geographical distribution of the various microscopical organisms is not only an important subject, but it is an extremely vexatious one. A great deal of study has been given to it, but we are yet very far from understanding this as well as other laws governing this kingdom. Why it is that these organisms grow vigorously in one pond and are at the same time absent from a neighboring one where the conditions are apparently as favorable, or why it is that they suddenly appear in ponds where hitherto they have never been seen, we are unable to say. Solution of these problems can only be accomplished by long continued observation and experiment, and by the working out of the life history of each particular organism. The following statistics are of some value in connection with this subject as they show the relative abundance of the different classes of organisms in some of the important surface water supplies of Massachusetts, together with some of the elements of the sanitary chemical analyses.

For the purpose of this comparison 57 ponds and reservoirs were selected where monthly examinations, both chemical and biological, have been carried on for a number of years by the State Board of Health. The results of these examinations were carefully studied and the ponds (which, for convenience, we may consider to include lakes, ponds and storage reservoirs) divided into groups as shown in Table 4.

The first two columns in this table give the names of the ponds and the cities which they supply. The third gives the depth of the pond, whether shallow or deep. The next four columns show the relative abundance of the four most important classes of organisms, namely, Diatomaceæ, Chlorophyceæ, Cyanophyceæ and Infusoria. The four groups are characterized as follows: and the group to which each pond belongs is indicated by a number.:

Group I. Number of organisms often as high as 1000 per c. c.

Group II. Number of organisms only occasionally as high as 1000 per c. c.

Group III. Number of organisms ordinarily between 100 and 500 per c. c.

Group IV. Number of organisms never above 100 per c. c.

These figures refer not to the numbers present in the average sample of water, but to the numbers during the season of maximum growth. The boundaries of the groups were not sharply defined, and in a number of cases it was hard to tell whether a pond should be classed in group II or III. The last five columns show the ponds divided into classes according to some of the elements of the chemical analysis, namely, color, excess of chlorine, hardness, albuminoid ammonia (in solution), free ammonia and nitrates. In each case four classes are given, division being made according to the schedule given at the bottom of the table.

TABLE NO. 4.

CLASSIFICATION OF FIFTY-SEVEN MASSACHUSETTS PONDS AND RESERVOIRS.

The figures refer to the classes to which the ponds belong.

City or Town	Pond or Reservoir	Depth	Diatomaceæ.	Chlorophyceæ.	Cyanophyceæ.	Infusoria.	Color.	Ex. of Chlorine.	Hardness.	Alb. Amo. (dis.)	Free Ammonia.	Nitrates
Abington,	Big Sandy Pond	0	3	4	4	3	1	3	1	2	1	2
Andover	Haggett's Pond	0	3	3	4	2	1	3	3	3	1	1
Ashburnham	Upper Naukeag Pond	0	4	4	4	3	1	1	1	1	1	1
Athol	Phillipston Reservior	0	3	2	2	3	2	2	2	2	2	2
Boston	Reservoir No. 6	+	3	4	4	3	3	3	3	3	2	1
Boston	Reservior No. 4	+	3	3	4	4	3	2	3	4	2	2
Boston	Reservior No. 2	0	3	3	2	4	4	3	3	3	2	2
Boston	Reservior No. 3	0	1	3	2	3	3	3	3	4	3	3
Boston	Lake Cochituate	+	1	3	3	3	1	3	4	2	2	3
Boston	Farm Pond	0	3	3	3	1	1	3	3	3	2	3
Boston	Mystic Lake	+	1	1	3	1	1	4	4	3	4	4
Boston	Jamaica Pond	+	1	1	1	3	1	4	4	3	4	4
Brocton	Salisbury Brook Reservoir	0	1	3	4	3	3	2	2	4	2	2
Cambridge	Fresh Pond	+	1	2	2	3	1	4	3	3	4	4
Cambridge	Stony Brook Reservoir	0	1	3	3	2	3	3	3	3	3	3
Danvers	Middleton Pond	+	3	3	4	3	3	2	2	3	1	2
Fitchburg	Scott Reservior	+	1	3	4	3	1	2	2	2	1	1
Fitchburg	Falulah Reservior	0	1	3	3	3	1	2	2	2	2	2
Fitchburg	Meeting House Pond	0	4	4	4	3	1	2	2	2	1	1
Gardner	Crystal Lake	+	3	4	4	3	1	3	3	1	2	2
Gloucester	Dikes Brook Reservoir	0	2	3	4	4	2	1	1	3	3	1
Gloucester	Wallace Pond	0	3	4	4	3	3	2	2	4	2	1
Gloucester	Fernwood Lake	0	2	4	4	3	4	2	2	4	3	2
Hingham	Accord Pond	+	1	3	4	3	1	3	1	1	1	1
Hingham	Fulling Mill Pond	0	1	3	3	3	1	3	3	1	4	3
Hinsdale	Storage Reservior	0	2	2	4	3	2	1	2	2	1	1
Holyoke	Whiting Street Reservoir	0	2	3	2	1	1	2	4	3	1	3
Holyoke	Ashley Pond	0	1	4	4	3	1	2	4	3	2	2

Hudson	Gates Pond	+	3	3	3	3	1	2	2	2	2	2
Leominster	Haynes Reservoir	0	1	2	2	3	2	1	1	4	3	2
Lynn	Breeds Pond	0	1	3	3	3	2	2	3	3	3	2
Lynn	Birch Pond	0	1	3	3	2	2	2	3	4	3	2
Lynn	Walden Pond	0	1	2	1	1	3	1	2	4	4	2
Lynn	Glen Lewis Pond	0	1	1	1	1	3	1	2	4	4	2
Malden	Spot Pond	+	2	2	3	3	1	3	4	3	3	2
Marlboro	Lake Williams	0	3	2	3	3	1	3	3	3	1	2
Montague	Lake Pleasant	+	3	4	4	4	1	2	1	1	2	2
Nantucket	Wannacomet Pond	0	3	3	3	2	1	1	3	4	2	2
Natick	Dug Pond	+	2	3	3	3	1	4	4	3	3	4
New Bedford	Lake Quittacus	0	4	3	3	4	4	2	2	3	2	3
North Brookfield	Doane Pond	0	3	3	4	2	3	3	3	4	3	2
Norwood	Buckmaster Pond	0	2	4	4	1	1	3	2	3	3	2
Orange	North Pond	0	2	3	4	3	3	3	2	3	2	1
Plymouth	Little South Pond	0	4	3	3	3	1	1	1	2	2	1
Quincy	Storage Reservoir	0	1	2	2	3	4	3	2	2	3	3
Rockport	Cape Pond	0	1	3	2	3	1	3	3	3	1	1
Salem	Wenham Lake	+	1	3	3	3	1	3	4	2	2	2
Springfield	Ludlow Reservoir	0	1	1	1	2	2	2	3	4	3	2
Taunton	Assawamsett Pond	0	3	4	4	4	2	3	2	2	1	1
Taunton	Elders Pond	0	4	4	4	4	1	3	1	2	1	1
Westborough	Upper Sundra Reservoir	0	3	2	2	3	2	3	1	3	3	1
Winchester	North Reservoir	0	1	2	1	1	1	4	4	3	3	3
Winchester	South Reservoir	0	3	3	3	3	2	2	4	4	3	2
Winchester	Middle Reservoir	0	4	3	1	3	3	3	3	4	3	1
Woburn	Horn Pond	+	1	1	1	1	2	4	4	4	4	4
Worcester	Lynde Brook Reservoir	0	3	2	2	3	1	2	3	2	3	2
Worcester	Tatnuck Brook Reservoir	0	1	3	3	3	2	1	2	2	2	2

DEPTH. + Deep
0 Shallow

ORGANISMS. 1. Often above 1000 per c.c.
2. Occasionally above 1000 per c. c.
3. Usually from 100 to 500 per c. c.
4. Below 100 per c. c.

COLOR. 1. 0 to 0.30 Nessler Scale.
2. 0.30 to 0.60 Nessler Scale.
3. 0.60 to 1.00 Nessler Scale.
4. 1,00 to —— Nessler Scale.

EXCESS OF CHLORINE, 1. 0
2. .01 to .03
3. .04 to .25
4. .25 to

HARDNESS. 1. 0 to 0.5
2. 5 to 1.0
3. 1.0 to 2.0
4. 2.0 to

ALBUMINOID AMMONIA (dissolved) 1. 0 to .0100
2. .0100 to .0150
3. .0150 to .0200
4. .0200

FREE AMMONIA. 1. 0 to .0010
2. .0010 to .0030
3. .0030 to .0100
4. .0100 to

NITRATES. 1. 0 to .0050
2. .0050 to .0100
3. .0100 to .0200
4. .0200

The figures of the chemical analyses are given in parts per 100,000.

If we consider the ponds with reference to the growths of organisms, we obtain from the above table the following summary:

TABLE No. 5.

Group	Number per c. c.	Number of Ponds and Reservoirs			
		Diatomaceæ.	Chlorophyceæ.	Cyanophyceæ.	Infusoria.
I	Often above 1000 per c. c.	24	5	7	8
II	Occasionally above 1000 per c. c.	8	11	10	7
III	Usually between 100 & 500 per c. c.	19	29	18	35
IV	Below 100 per c. c.	6	12	22	7

From this it appears that the Diatomaceæ are the organisms most commonly found in large numbers. There are 24 ponds (42 per cent of the ponds considered) which often have these organisms as high as 1000 per c. c., while in only 6 (11 per cent) are they always below 100 per c. c. The Chlorophyceæ are not often found in great abundance, though many ponds contain them in moderate numbers. Only 5 ponds (9 per cent) have growths of 1000 per c. c., while 29 (70 per cent) have growths of from 100 to 500 per c. c. The Cyanophyceæ are not as common as the Chlorophyceæ, but where they do occur their growth is usually greater and they cause more trouble. There are 7 ponds (12 per cent) that commonly have growths above 1000 per c. c., while in 22 (39 per cent) they are never above 100 per c. c. The Infusoria are somewhat more abundant than either the Chlorophyceæ or Cyanophyceæ. 8 ponds (12 per cent) often have growths above 1000 per c. c.; 35 ponds (60 per cent) have growths between 100 and 500 per c. c.

From Table 4 it also appears that 28 ponds (49 per cent) often have high growths of one or more of these classes of organisms at one time or another during the year. Such growths, except in the case of certain diatoms, are almost always noticeable and frequently are very troublesome. In seventeen ponds the Diatomaceæ alone reach 1000 per c. c.; in one pond the Cyanophyceæ alone; and in three ponds the Infusoria alone. One pond has high growths of Diatomaceæ, Chlorophyceæ and Infusoria; two of Diatomaceæ, Chlorophyceæ and Cyanophyceæ; two of Diatomaceæ, Cyanophyceæ and Infusoria. In two ponds all four classes are found in large numbers. There is but one pond where the organisms never rise above 100 per c. c.; there are sixteen where no class of organisms shows numbers greater than 500 per c. c.

For the purpose of determining whether the depth of the pond exercises any important influence upon the growth of the organisms the following table has been compiled. Ponds reported as having a maximum depth of more than 30 feet have been called "deep ponds," and those having a less maximum depth "shallow ponds." This arbitrary dividing line was selected after considering the relation between the maximum and the average depth, the temperature changes at various depths, and the depth to which the water is kept in circulation by the wind. In a general way it may be said that the shallow ponds are those in which the water is kept in vertical circulation by the wind over the greater part of their area and for the greater portion of the year, while the deep ponds exhibit the phenomena of stagnation over a considerable portion of their area.

TABLE No. 6.

Depth	Number per c. c.	Number of Ponds			
		Diatomaceæ.	Chlorophyceæ.	Cyanophyceæ.	Infusoria.
Deep	Often above 1000 per c. c.	8	3	2	2
Deep	Occasionally above 1000 per c. c.	2	2	1	0
Deep	Usually between 100 & 500 per c. c.	6	8	6	12
Deep	Always below 100 per c. c.	0	3	7	2
Shallow	Often above 1000 per c. c.	16	2	5	6
Shallow	Occasionally above 1000 per c. c.	6	9	9	7
Shallow	Usually between 100 & 500 per c. c.	13	21	12	23
Shallow	Always below 100 per c. c.	6	9	15	5

There are 16 deep and 41 shallow ponds. Of the deep ponds 63 per cent at times have growths of the Diatomaceæ above 1000 per c. c., while of the shallow ponds 54 per cent have such growths. There are no deep ponds where the Diatomaceæ are lower than 100 per c. c., while 15 per cent of the shallow ponds have them lower than that figure. It thus appears that the heavy growths of the Diatomaceæ are somewhat more likely to be found in the deep than in the shallow ponds. The same may be said of the Chlorophyceæ, though the difference is not so marked. 31 per cent of the deep ponds and 27 per cent of the shallow ponds at times have growths as high as 1000 per c. c. The Cyanophyceæ and Infusoria, on the other hand, incline towards shallower water. In the case of the former, 18 per cent of the deep ponds and 34 per cent of the shallow ponds at times have growths of 1000 per c. c., while in the case of the latter the figures are 12 per cent and 32 per cent respectively.

In this connection it would be of interest to show statistically the relation that undoubtedly exists between the growths of organisms and the character of the material forming the bottoms of the ponds, but unfortunately the necessary data is lacking in too many cases. So far as observations have been made, however, it appears that muddy bottoms are very largely responsible for the excessive growth of microscopical organisms.

An important question, and one which is of particular interest to water analysts, is the relation between the growths of organisms and the chemical analysis of the water in which the organisms are found. Unquestionably there is such a relation, and we should very much like to be able to take up a chemical analysis and say "this water contains such and such substances in solution, and, therefore, such and such organisms may be expected to thrive well in it." In other words, we desire to know better the nature of the necessary food supply of the microscopical organisms.

The following tables are designed to show in a very general way the relation between the organisms in our 57 selected ponds and some of the important elements of the chemical analysis. These bring out several important facts.

First, it is seen that the color of a water has an important influence upon the number of organisms that will be found therein. Of the 24 cases where the Diatomaceæ are commonly found higher than 1000 per c. c., 12 (or 50 per cent) occur in light colored waters, i. e., water having a color lower than 0.30

TABLE No. 7.

Chemical Analyses (parts per 100,000).		Number of Ponds and Reservoirs in which Diatoms are			
		Often above 1000 per c. c.	Occasionally above 1000 per c. c.	Usually between 100 & 500 per c. c.	Below 100 per c. c.
Color (Nessler Scale)	.0 to .30	12	4	9	4
	.30 to .60	6	2	4	0
	.60 to 1.00	6	1	5	1
	1.00 to ——	0	1	1	1
Excess of Chlorine	0	4	2	1	2
	.01 to .03	8	1	8	2
	.04 to .25	8	3	10	2
	.25 to ——	4	2	0	0
Hardness	0 to .5	2	1	3	3
	.5 to 1.0	7	4	5	2
	1.0 to 2.0	8	0	10	1
	2.0 to ——	7	3	1	0
Albuminoid Ammonia (dissolved)	0 to .0100	2	0	2	1
	.0100 to .0150	6	1	5	3
	.0150 to .0200	8	6	7	1
	.0200 to ——	8	1	5	1
Free Ammonia	.0000 to .0010	3	2	5	3
	.0010 to .0030	6	1	10	2
	.0030 to .0100	8	5	4	1
	.0100 to ——	7	0	0	0
Nitrates	0 to .0050	3	3	5	6
	.0050 to .0100	11	3	13	0
	.0100 to .0200	6	2	1	0
	.0200 to ——	4	1	0	0

TABLE No. 8.

Chemical Analysis (parts per 100,000).		Number of Ponds and Reservoirs in which the Chlorophyceæ are			
		Often above 1000 per c. c.	Occasionally above 1000 per c. c.	Usually between 100 & 500 per c. c.	Below 100 per c. c.
Color (Nessler Scale)	0 to .30	2	5	14	8
	.30 to .60	2	4	5	1
	.60 to 1.00	1	2	8	2
	1.00 to ——	0	0	2	1
Excess of Chlorine	0	1	3	4	1
	.01 to .03	1	2	11	5
	.04 to .25	0	4	13	6
	.25 to ——	3	2	1	0
Hardness	0 to .5	0	2	3	4
	.5 to 1.0	1	4	8	5
	1.0 to 2.0	1	3	13	2
	2.0 to ——	3	2	5	1
Albuminoid Ammonia (dissolved)	0 to .0100	0	0	2	3
	.0100 to .0150	0	4	7	4
	.0150 to .0200	2	5	12	3
	.0200 to ——	3	2	8	2
Free Ammonia	0 to .0010	0	2	7	4
	.0010 to .0030	0	1	13	5
	.0030 to .0100	2	5	8	3
	.0100 to ——	3	3	1	0
Nitrates	0 to .0050	0	2	8	6
	.0050 to .0100	2	6	13	6
	.0100 to .0200	0	2	7	0
	.0200 to ——	3	1	1	0

TABLE NO. 9.

Chemical Analysis (parts per 100,000).		Number of Ponds and Reservoirs in which the Cyanophyceæ are			
		Often above 1000 per c. c.	Occasionally above 1000 per c. c.	Usually between 100 & 500 per c. c.	Below 100 per c. c.
Color (Nessler Scale)	0 to .30	2	4	12	11
	.30 to .60	2	3	4	3
	.60 to 1.00	3	2	1	7
	1.00 to —	0	1	1	1
Excess of Chlorine	0	2	1	3	3
	.01 to .03	1	3	5	10
	.04 to .25	1	5	8	9
	.25 to —	3	1	2	0
Hardness	0 to .5	0	2	1	6
	.5 to 1.00	2	2	4	10
	1.00 to 2.00	2	5	7	5
	2.00 to —	3	1	6	1
Albuminoid Ammonia (dissolved)	0 to .0100	0	0	1	4
	.0100 to .0150	0	3	6	6
	.0150 to .0200	2	5	8	7
	.0200 to —	5	2	3	5
Free Ammonia	0 to .0010	0	2	1	10
	.0010 to .0030	0	2	9	8
	.0030 to .0100	3	5	6	4
	.0100 to —	4	1	2	0
Nitrates	0 to .0050	1	2	1	12
	.0050 to .0100	3	4	10	10
	.0100 to .0200	1	3	5	0
	.0200 to —	2	1	2	0

TABLE NO. 10.

Chemical Analysis (parts per 100,000).		Number of Ponds and Reservoirs in which the Infusoria are			
		Often above 1000 per c. c.	Occasionally above 1000 per c. c.	Usually between 100 & 500 per c. c.	Below 100 per c. c.
Color (Nessler Scale)	0 to .30	5	2	20	2
	.30 to .60	1	3	6	2
	.60 to 1.00	2	2	8	1
	1.00 to —	0	0	1	2
Excess of Chlorine	0	1	2	5	1
	.01 to .03	1	2	13	3
	.04 to .25	2	3	15	3
	.25 to —	3	0	3	0
Hardness	0 to .5	0	0	7	3
	.5 to 1.00	3	0	12	2
	1.0 to 2.0	1	6	10	2
	2.0 to —	4	1	6	0
Albuminoid Ammonia (dissolved)	0 to .0100	0	0	4	1
	.0100 to .0150	0	0	13	2
	.0150 to .0200	5	2	12	3
	.0200 to —	3	4	7	1
Free Ammonia	0 to .0010	1	1	9	2
	.0010 to .0030	1	1	13	4
	.0030 to .0100	2	5	10	1
	.0100 to —	4	0	3	0
Nitrates	0 to .0050	0	1	12	3
	.0050 to .0100	3	4	17	3
	.0100 to .0200	3	2	3	1
	.0200 to —	2	0	3	0

on the Nessler scale, and none occur in water where the average color is above 1.00. The same fact is noticed in the case of the other organisms, but not as strongly emphasized as with the Diatomaceæ. The reason for this is doubtless on account of the difference in specific gravity between the diatoms and the other organisms. The diatoms, by reason of their silicous cell walls are heavy, while the other organisms not only are much lighter, but some of them liberate gas, causing them to keep near the surface. Being thus kept near the surface, the depth to which light penetrates in a body of water makes less difference with the growth of the Cyanophyceæ, for example, than it does with the diatoms, which constantly tend to sink, and which are kept near the surface chiefly by the vertical currents in the water.

The "excess of chlorine" means the difference between the amount of chlorine found in a sample of water and that found in the unpolluted water of the same region. To a certain extent it represents the amount of pollution which the water has received. It is important to know whether this element of the analysis bears any relation to the organisms and whether one may rightly infer that a large growth of organisms in a reservoir is any indication of the pollution of a water supply. A study of the tables shows that only to a small extent does the excess of chlorine influence the number of organisms observed, though there is a slight tendency for heavy growths of organisms to accompany high excess of chlorine. This fact corresponds with the common observation that vigorous growths of organisms are often observed in ponds far removed from any possible contamination.

The hardness of a water, i. e., the abundance of carbonates of calcium and magnesium, appears to have some influence upon the organisms. This is noticed in all four classes, though it is most marked in the case of the Diatomaceæ and Infusoria. For example, of the 10 ponds low in hardness not one ever has the Infusoria as high as 1000 per c. c., while of the 11 ponds high in hardness not one but that has Infusoria above 100 per c. c., and 4 of them commonly have them above 1000 per c. c.

The sanitary chemical analysis ordinarily states the amount of nitrogen present in four different forms, namely, albuminoid ammonia (dissolved and suspended), free ammonia, nitrites and nitrates, which represent four stages in the change of organic to inorganic matter. Since nitrogen is essential to all living matter we naturally expect that organisms will thrive best in waters rich in that element. Our statistics show that this is the case, and that it is true for each class of organisms and for the different conditions of nitrogen tabulated. The free ammonia and nitrates appear to be particularly influential in determining the amount of life present. For example, 10 of the 13 ponds low in free ammonia never show maximum growths of the Cyanophyceæ above 100 per c. c., while 4 of the 7 ponds high in free ammonia commonly have growths above 1000 per c. c.

One must be careful in these matters, however, not to mistake cause for effect. Free ammonia, for example, indicates organic matter in a state of decay, and instead of representing the food of the organisms in question it may represent their decomposition. The interaction of the various organisms is a very complicated question, and to what extent one species lives upon the products of decay of another is not well known. The food supply of the different organisms can only be determined by experiments made upon pure cultures, and this subject is as broad as the host of the microscopical organisms is numberless. For a long time we have been groping in darkness, but the active interest which is awaking in the study of the plankton gives us hope to believe that light has begun to dawn.

HAMMAR'S ECTOPLASMIC LAYER.

BY E. A. ANDREWS.

Twenty years ago Selenka observed and figured a connection between the outer parts of the cells in cleaving eggs of several Echinoderms, but it remained for Professor Hammar to point out, in 1895,[1] the great significance of this intercellular structure.

In the sea urchin, *Echinus miliaris*, he found a thin outer coat that did not take part in cleavage, but remained as a continuous envelope over all the cells. This he interpreted as an ectoplasmic part of the egg, as a living connection between the cells, and as such of greatest import in understanding the interactions of cells in cleavage and in throwing light upon the divergent results of recent experimental work upon cleaving eggs. This, he thought, might be that organic intercellular connection potulated as probable by Whitman, Wilson and others.

Proof, however, of the living nature of this layer seems wanting; the figures of preserved sections raise a question as to how far the result may be due to or affected by the reagent used; and that the layer has a structure somewhat like an alveolar layer of Bütschli indicates, but does not prove, that the layer was actually living substance.

Later, E. B. Wilson[2] stated that he had, in the main, verified Hammar's results upon sea urchin eggs, presumably upon preserved material also.

The same objection may be raised against accepting all the results subsequently obtained by Hammar,[3] for though he found the outer ends of the cleaving cells of the eggs in Cœlenterates, Annelids, Molluscs, Arthropods and Tunicates connected by a thin line of substance, and though a similar connection is shown in the epithelium of young vertebrate embryos, yet the

[1] Archiv. f. Mik. Anat., V, 47.

[2] The Cell, p. 43. Macmillan Co.. N. Y.

[3] Archiv. f. Mik. Anat., 49.

nature of the methods employed, the use of corrosive sublimate solution to shrink the cells apart save at the outer surface, raises grave suspicion as to the real nature of this outer connection.

Some observations upon living eggs of Lamellibranchs seem, however, to strengthen the position assumed by Hammar and to make it probable that the intercellular connection observed by him is, in some cases at least, really a living ectoplasma.

It is well-known that eggs frequently present a clear outer protoplasm that forms a true ectosarc over the more granular, yolk bearing interior part. In the eggs of the Lamellibranch, *Nucula delphinodonta,* this is very marked. Here the ectosarc rises up into waves and also into blunt pseudopodia-like papillæ, as seen under oc. 8. obj. 4 mm. These waves and processes change shape in such a way as to leave no doubt of the living nature of this ectosarc. In one case the ectosarc extended all over the polar body, so that it was included as a bubble might be escaping through a film of jelly, and a clear stalk or base of ectosarc was left between the egg and the polar body. But as these eggs were probably never fertilized and did not develop, the above phenomena may well have been abnormal.

Yet in another Lamellibranch, *Angulus tener,* much the same was seen: figure 1, drawn from camera sketches of the living egg with oc. 4, obj. 2 mm., indicates the ectosarcal waves and a polar body buried in the ectosarc that surrounds it. In the two-cell stage marked ectosarcal waves rise up like frills on each side of the cleavage plane. When these cells divide to make four, the ectosarc is seen to follow the groove as it sinks down, figure 2, and not to leave the surface as Hammar described in Echinus. When the actual cleavage plane cuts

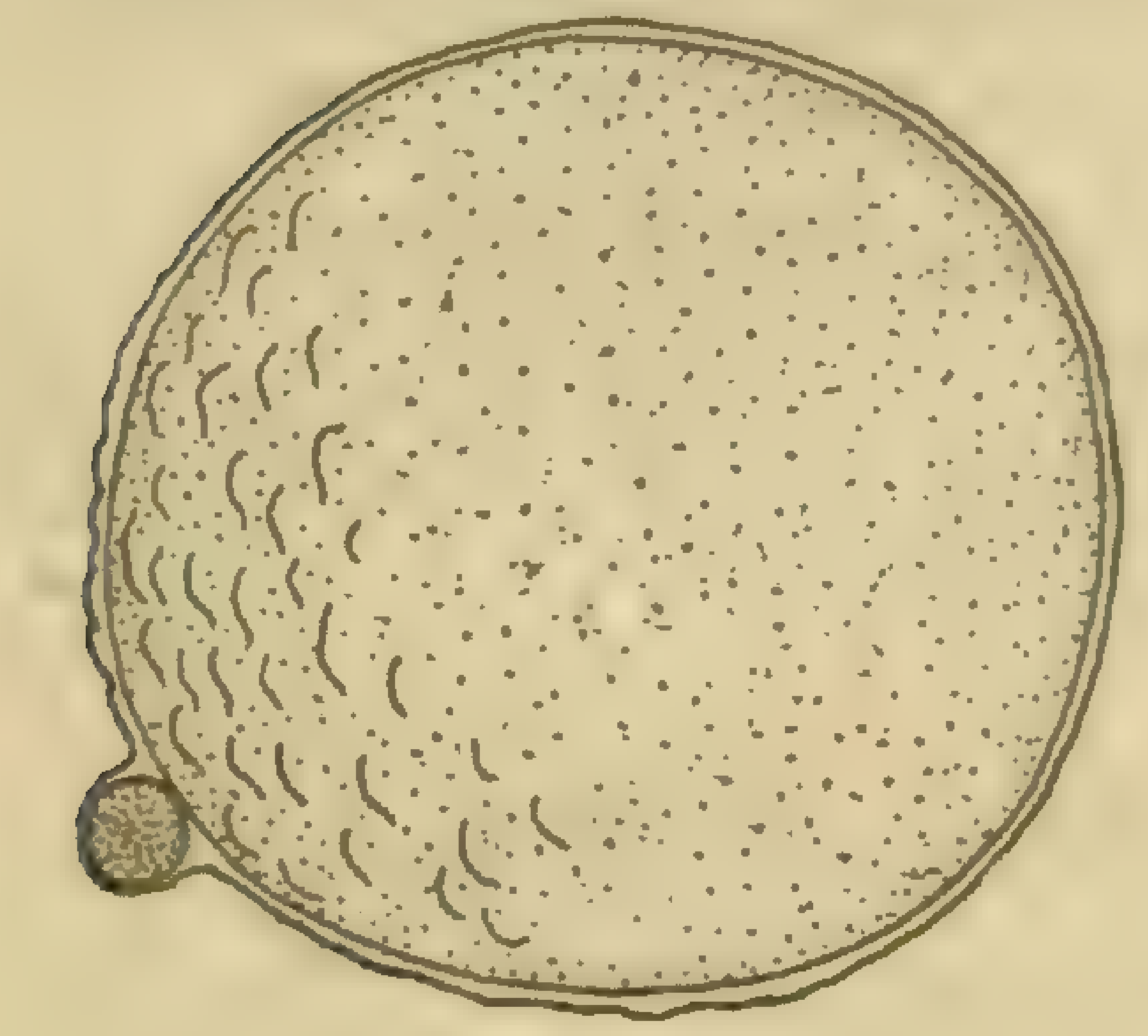

FIG. 1.

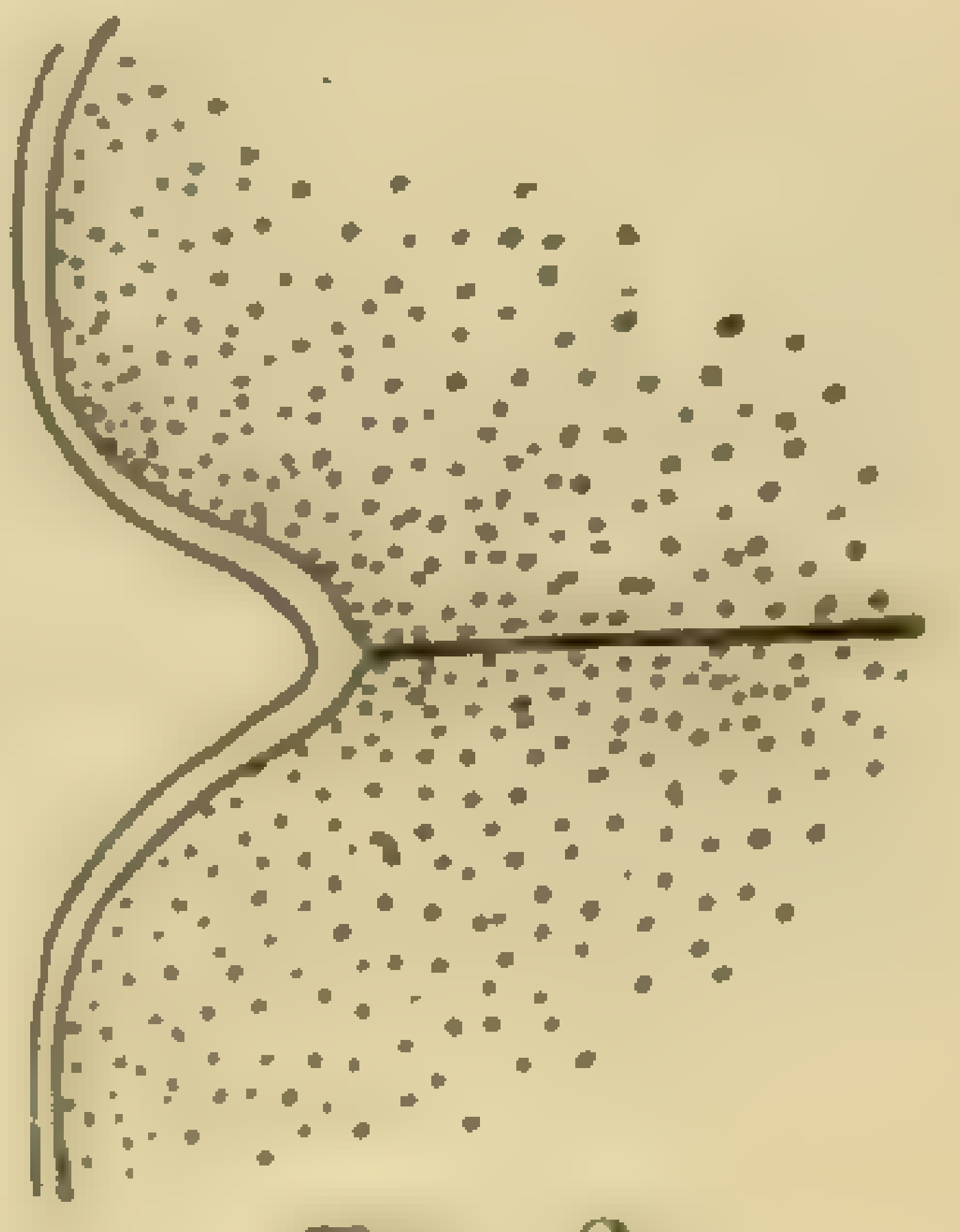

FIG. 2.

across the cell it does not affect the ectosarc which thus remains continuous from one cell to the other, figure 2. When the four cells formed flatten out against one another, figure 3, the ectosarc is continuous all over the egg, and not cut by the cleavage planes. That this is still a living ectosarc seems to be shown by the waves that rise up in it, especially over the smaller cells where they may be very high and sharp.

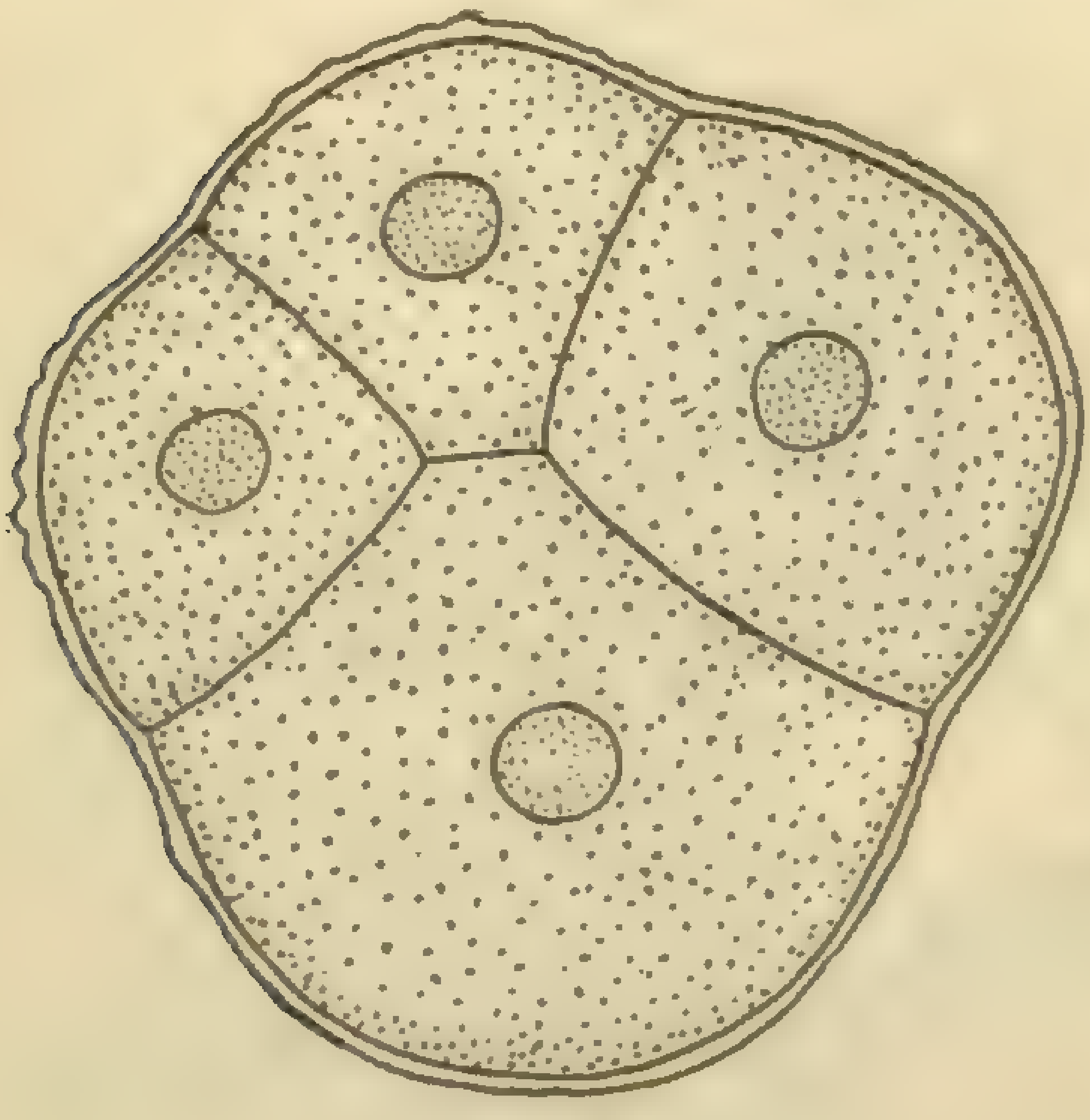
FIG. 3.

Similar waves were seen in the one cell stages of Yoldia, and may be common enough in Lamellibranchs. Thus Professor Brooks, in 1880,[4] called attention to contraction waves in the egg of the oyster. His figures indicate a clear outer layer continuous over all the cells in various stages of cleavage, and, apparently, continuous with the polar bodies which adhere together and to this layer up to a late stage of cleavage, *and in spite of the fact that a membrane is thrown off early in the cleavage.* It would seem necessary to interpret this layer as a living, membrane-forming substance, though with the low powers used, the wavy appearance figured was interpreted as being a wrinkling produced by contractions "which travel rapidly toward the formative pole, near which they disappear" (p. 42). These wrinkles vanished in about fifteen seconds, but came again upon other cells later in cleavage. It seems probable that further study will show that such waves are largely due to contractions in the ectosarc itself, as they seem to be in the cases I have examined with higher powers.

The connection between such ectosarcal portions of the Lamellibranch egg and the ectoplasmic layer of the Echinoderm egg is indicated by the appearance seen in figure 4. This represents a surface view of the opening into the cleavage cavity of a four-cell stage of the Echnius common at Roscoff, France, and was drawn from a *preserved* egg with camera lucida, oc. 18 and obj. 2 mm. A thin film of broken vesicular appearance stretches across the cleavage pore from one cell to the other, and is continuous with the surfaces of the cells, except where they arch down between the cells and on the sides of the cleavage pore. This film is absent, or broken, over part of the cleavage pore and beneath it are certain linear structures to be mentioned later.

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[4] Development of the American Oyster. Report of the Commissioners of Fisheries of Maryland, 1880.

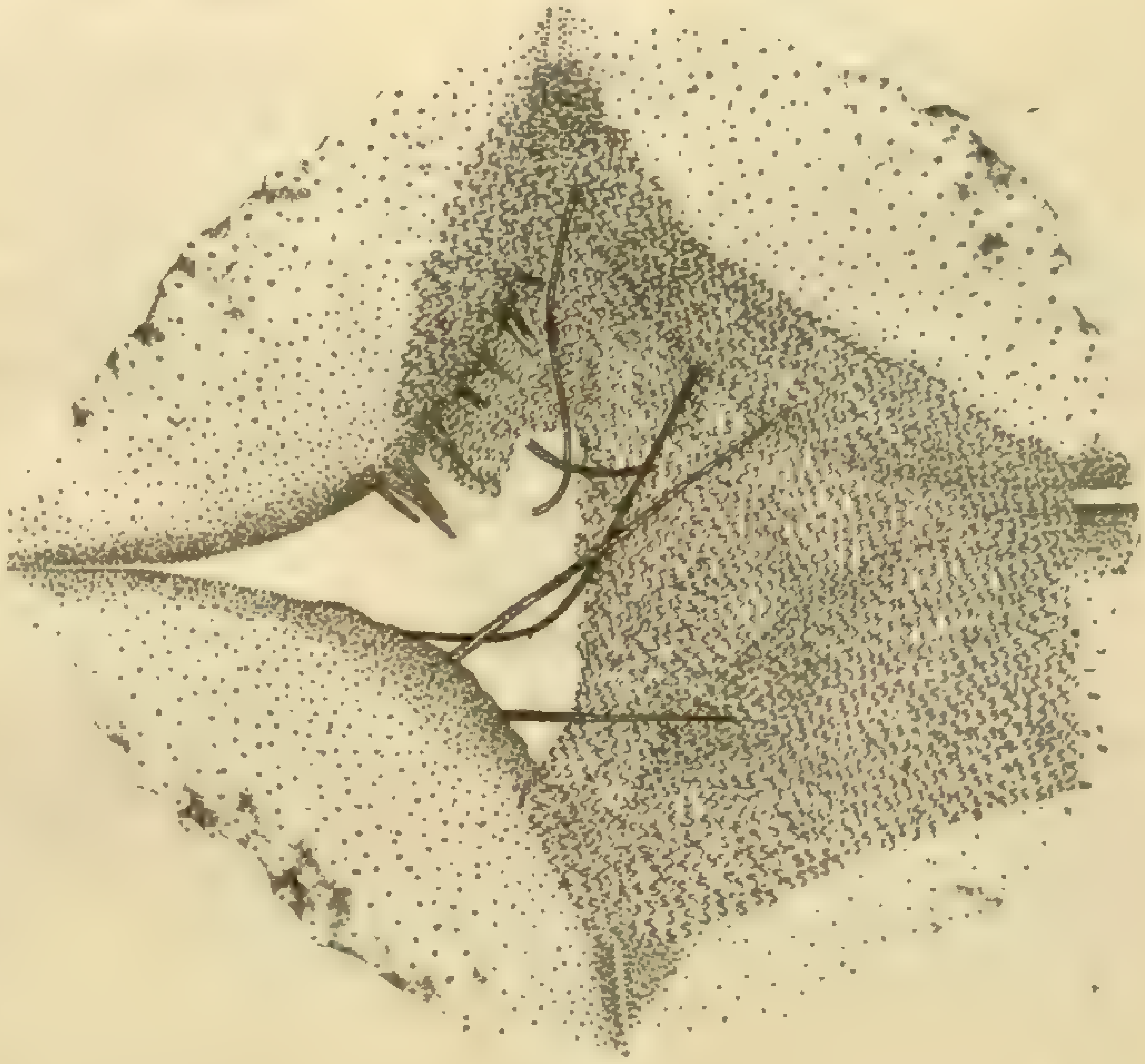

FIG. 4.

The peculiar official appearance of the layer makes it highly probable that it was a living ectosarcal substance extending from one cell to others. As such it seems the same as the continuous ectosarc of the Lamellibranch. It would appear to be the same thing seen by Hammar in Echinoderms both in section and in surface view—"In der Interstitien der Zellen kann man unter günstigen Umständen das abgehobene Ectoplasma auch im Flächenbild zum Gesichte bekommen" (1, p. 16).

We would conclude that the *living, ectosarcal,* membrane-like connection between the outer parts of cleavage cells actually exists in some eggs, whether in all the cases claimed by Hammar is still in doubt.

Another form of intercellular connection has been described by G. F. Andrews[5] in the cleaving eggs and larvæ of sea urchins and star fish; namely, fine filaments of living substance that are spun out from one cell to another much as a filose Rhizopod might connect with another by means of its delicate pseudopodia.

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[5] Some Spinning Activities of Protoplasm. Journal of Morphology. Vol. XII, 1897.

Figure 4 indicates the difference between the two modes of intercellular connection as seen in *preserved* material, where, however, the threads are fewer, thicker and otherwise altered by the Killing fluid and by subsequent treatment. Beneath the outer film of connecting substance and on various levels, (some quite far down), very definite protoplasm-like threads extend out from a cell and crossing the cleavage cavity become continuous with the surface of some other cell. These filaments have a characteristic shape, mode of origin, insertion, structure and size. They are the altered remnants and representatives of the living filaments seen in the live egg. Besides the long filaments the specimen shows pseudopodia-like processes or tufts of threads, arising from one of the four cells. These came upward toward the membrane-like expanse and seemed to be continuous with it, so that the filamentous substance and the filmy expanse appeared to have been one common material.

In life the filaments are subject to flow and to change, and the same *may* be true of the ectosarcal expanse.

Though the filamentous and the membranous connections of cleaving cells seem so different, it is not improbable that they are both expressions of the same contractile powers in the ectosarcal part of the egg cell, and they both serve to make the living material continuous from one cell to another.

In the living eggs of representatives of widely separated groups of animals we thus see reasons for believing that the process of cleavage does not isolate the cells as much as has been thought; either the cells remain connected from the first and are but areas in a common mass of living material, or they may make and break connection with one another by living filaments, formed as fast as cleavage tends to organize the egg into cell areas. In preserved material we see remnants of such connections, and it becomes probable that such connections will be found throughout the animal series.

With the ever increasing knowledge of intercellular bridges in animals and in plants, and the recently demonstrated fact that in Echinoderms these bridges are used as means of transportation, that the filaments allow material to pass from one cell to another, being, like Gromri's pseudopodia, *unstable sensitive, conductive, contractile,* we are on the road to admit not only the existence of such statical ectosarcal connections as Hammar discovers, but to accept as working hypothesis a conception of these bridges as dynamical factors of the greatest importance.[1]

A NORTH AMERICAN FRESH WATER JELLY FISH.

BY EDWARD POTTS.

On June 10, 1880, the first known fresh water jelly fish (*Limnocodium sowerbii,* Allman & Lankester) was discovered in the Victoria Regia tanks in Regent's Park, London. Near the end of November, 1884, a primitive "hydriform organism" from which it was supposed the jelly fish might have been derived, was found in the same tanks and described by Alfred Gibbs Bourne.[2]

About two months after Mr. Bourne's discovery, I first detected *Microhydra ryderi* upon some stones collected the previous autumn from the rocky bed of Tacony Creek, a rapidly flowing mill stream near Philadelphia, Pennsylvania, a small affluent of the river Delaware, but far above tide level. Some peculiarities in its structure and mode of gemmiparous multiplication were described by my valued friend the late Dr. John A. Ryder.[3]

Dr. Ryder had not, at the time of writing the above paper, seen the living organism which he there described. Specimens were, however, some years later, placed in his hands for study and watched for many months with exceeding interest. His early death has left in the possession of his representatives many excellent drawings and some valuable micro-slides as the only evidences of his interest and labor. No descriptive text has been found, and the sorrow that his many friends feel at his early removal, has, to me, this added regret—that he was not able to complete an investigation, which, not unnaturally, perhaps, I felt to be of so great importance; and that he cannot now share with us our great delight in witnessing the further development from *Microhydra ryderi* of a "medusiform adult stage."

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[1] The Living Substance. G. F. Andrews. Boston: Ginn & Co., 1897.

[2] Proceedings of the Royal Society, Dec. 11, 1884, Vol. 38, p. 9, etc. See also paper by F. A. Parson, Jour. of Queckett Club, 2nd series, vol. 2, 1885–6.

[3] American Naturalist, Extr , Dec., 1886, p. 1232, etc.

As may be seen by a comparison of the papers above named, all of them preliminary and incomplete,—there are obvious points of resemblance as well as of difference between these minute organisms that appeared, almost simultaneously, at geographical points so widely distant. The supposition that the form observed by Mr. Bourne is the earlier condition of Limnocodium is, of course, greatly strengthened by my actual observation of the budding and separation of free-swimming Medusæ from *M. ryderi*.[1]

We read that the specimens of Limnocodium often, perhaps generally, disappeared from the tanks about the end of June or July.[2] It is greatly to be regretted that the glass jars containing my species were not carefully examined throughout June and July of the present year, during which period there may have been a larger production of maturing jelly fish. On the first day of August, however, my attention was arrested by the spasmodic contraction of an evident Medusa in the above-mentioned jar, and, during several following days, Prof. E. P. Cheyney and myself, on frequent occasions, watched the swelling buds upon colonies of *Microhydra* that had attached themselves to the glass. We witnessed the spreading of the disc, disclosing, from the first, eight marginal tentacles, a well-defined velum, whose aperture was from one-third to one-fourth the diameter of the disc, and a manubrium depending, about one-half the height (or depth) of the bell. Violent pulsating spasms finally resulted in an entire separation from the hydroid and the free life of a roving medusa. I kept no record of numbers, but it is believed that from twelve to twenty were seen.

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[1] This alternation and progression may have been seen, later, in England, but I shall have to plead ignorance of the fact.

[2] In one case "swarms" are reported Aug. 18, 1882, at Kew Gardens.

Measurements were difficult, but as nearly as I could make it out, the jelly fish was, at this time, about one-thirty-second of an inch in diameter. It was of a somewhat prolate dome-shape, and when seen from the polar aspect, the manubrium had a clearly quadrate appearance, from whose corners or lobes four radial canals curved downward to the marginal canal. At every point of junction occurred a single tentacle, and another of equal size was found midway between them. These eight tentacles (the only number as yet observed), always pendent, were plentifully charged with thread cells, and, while susceptible of much variation in length, were not seen much longer than one-half the diameter of the disc.

As to temperature, it is obvious that the water of the jars in which this Medusa was developed, must have had nearly that of the surrounding atmosphere, with its diurnal changes, say from 60° to 85° at this season: during the winter, in our heated rooms, the temperature is probably more uniform. The hydroid form, in Tacony Creek, being but a few inches below the surface, must be subjected frequently to a temperature at or below the freezing point.

It is quite improbable that under the present artificial conditions, any Medusæ will attain full maturity this season. It is therefore manifestly unsafe to compare their minute size and general appearance with the totally dissimilar drawings given us of *Limnocodium*, where the latter had attained a diameter of about one-half an inch. The full life-history of the organism must, therefore, be again left imperfectly recorded; but I am happy to be able to state that my friend, Dr. Charles B. Davenport, of Harvard University, has consented to undertake the further technical study of it from material we have recently collected; and the drawings, etc. left by Dr. Ryder and to hope that many points, now obscure, may, through his efforts, be solved.

To aid the search of others for this—probably the most primitive cœlenterate—it may be well to state that, in my experience, I have only found *M. ryderi* in a natural condition, living as a messmate among colonies of Bryozoa that may be considered almost perennial in habit, where its own disabilities as a food collector, on account of local inertia and the total absence of tentacles, were supplemented by the life sustaining currents induced by its more active neighbors. These conditions are near Philadelphia furnished by *Urnatella gracilis* Leidy and *Pottsiella erecta* Kræpelin (*Paludicella erecta* Potts). I regret to be obliged to add that I am not aware that either of these has been collected in any other neighborhood.

Philadelphia, August 19th, 1897.

SOME OBSERVATIONS ON THE PHYSIOLOGICAL FUNCTION OF THE PYLORIC CÆCA OF ASTERIAS VULGARIS.

BY ELLEN A. STONE.

The size and position of the pyloric cæca of our common star-fish, *Asterias vulgaris*, indicate an organ of great importance, yet their physiological function has been surprisingly little touched upon in any of the standard text-books of zoology. The most we can learn from them is a confused notion that they secrete some digestive fluid, which, according to some authors, is of unknown function, while others state that it is probably the representative of the bile of higher animals.

Dr. Griffiths and Dr. Fredericq, however, have demonstrated in the European species, *Uraster rubens*, the presence of active digestive ferments.[1] Their results, together with the abundant material and opportunity for studying these organs in Asterias, suggested the following experiments, which were carried on at the Laboratory of Physiological Chemistry, Brown University, under the direction of Mr. Ralph W. Tower.

The experimental methods and results are embodied in the following observations:

A. PRELIMINARY EXAMINATION OF THE GLAND.

I. *The Reaction of the Secretion.*

Before making any examination for the ferment or ferments that might be contained in the secretion of the pyloric cæca, the glands were first examined as to the nature of the reaction of this secretion, and this was found to be slightly acid since it produced a tinge of red in a neutral solution of litmus. This trace of acidity, however, was found to be due to some organic acid, since a neutral solution of tropaeolin 000, which is extremely sensitive to mineral acids, showed no change in color upon the addition of a small piece of the freshly crushed glands.

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[1] A. B. Griffiths, "Physiology of the Invertebrata," pp. 83–85.

II. Examination for Leucine.

For the extraction of leucine, should any be present, the glands of several star-fishes were macerated with water and allowed to stand for some time. After filtering through cheese-cloth the filtrate was acidulated with acetic acid and boiled. A considerable coagulum of native albumen appeared, which was filtered off, and to the filtrate lead acetate added. The small precipitate was filtered off and sulphuretted hydrogen passed through the filtrate to remove the excess of lead. This precipitate was removed by filtration and the filtrate then evaporated to dryness. The residue was extracted with boiling alcohol, filtered and evaporated to a syrup. On standing, knots of crystals collected on the sides of the beaker which showed, by microscopic examination, the characteristics of very impure leucine. They could not, however, be certainly identified as such, since their quantity was insufficient to try Scherer's test. In all probability, however, if this method were applied to a number of glands sufficient to give a considerable yield of crystals, they could be purified and would undoubtedly prove to be leucine with probably some clusters of tyrosin.

B. PROOF OF THE NON-EXISTENCE OF GLYCOGEN.

In determining whether the function of the pyloric cæca of the star-fish is more similar to that of the liver or to that of the pancreas of higher animals, one of the most reliable criteria would be the existence or non-existence of glycogen in the organ.

Therefore the cæca of about twenty living star-fishes were quickly removed and placed in boiling water where they were allowed to boil for some time ; the liquid was then filtered off and Pflüger's method for extracting glycogen[2] was carefully carried out. At the end of the process a portion of the resulting liquid gave with dilute iodine a very slight mahogany color, which seemed to indicate the presence of a little glycogen. But on boiling the remaining portion of the extract with dilute hydrochloric acid for half an hour, and then neutralizing with sodium hydrate, no substance was produced which would reduce Fehling's solution. The total amount of glycogen present in the glands of these twenty star-fishes must, therefore, have been very small, thus indicating that these organs do not possess a function characteristic of the true livers of higher animals. The following experiment also confirmed this view: Working upon the supposition that if glycogen were present in the pyloric cases, it would almost immediately be converted into glucose, the glands of several star-fishes were removed and allowed to stand in an open dish for about half an hour. At the end of that period a cold water extract was made of one portion while a hot water extract was made of another part. Both extracts were subjected to the test for glucose with Fehling's solution, and neither gave the slightest reduction, thus showing that the glands contained no glucose, and hence no antecedant of glucose in the form of glycogen.

C. Examination for Digestive Ferments.

I. Proteolytic Ferment.

In carrying out this examination the proteid used was coagulated egg albumen, which was experimented upon in the following manner:

The white of one boiled egg was cut into small pieces and placed in 1000 cc. of a mixture of a 1 per cent. solution of sodium carbonate ($Na_2 CO_3$) and sodium bi-carbonate ($NaHCO_3$) to which was added 100 cc. of a fresh water extract of the pyloric cæca of the star-fish and the whole was digested for 48 hours at a temperature of 37°C, the medium being kept free from bacteria by the presence of thymol. At the end of this period the albumen appeared considerably corroded and easily crumbled upon slight pressure between the fingers.

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[2] **Pflüger's Archiv. fur Physiologie, 1894, pp. 394–396.**

The substance was filtered and the filtrate then neutralized with dilute hydrochloric acid, upon which a slight precipitate of albuminate appeared. This was separated by filtration and the filtrate boiled, when a considerable coagulum of native albumen occurred. The native albumen was filtered off and the fluid then evaporated to about 300 cc.

To this concentrated fluid strong alcohol was added in considerable excess upon which a copious fine floculent precipitate of albumoses and peptones appeared which slowly settled to the bottom of the beaker. This precipitate was collected upon a filter and dissolved in 600–700 cc. of water. The precipitate completely dissolved, yielding an opalescent fluid which gave a strong xanthoproteic reaction and also a characteristic biuret test tending more strongly towards the rose-pink of a peptone. Ammonium sulphate was added to this solution in the form of crystals till the whole was completely saturated, and after standing for several hours a copious precipitate of albumoses gathered. This precipitate of albumoses was separated by filtration and the fluid was then treated with barium carbonate and barium hydroxide to precipitate the sulphate from the solution. After repeated treatments all the sulphate was finally precipitated and removed by filtration and the fluid was then boiled to a small bulk. About three volumes of strong alcohol were added and a fine floculent precipitate appeared which settled on standing. This precipitate was collected and dissolved in water, and the solution then gave the various characteristic reactions for peptones.

The first alcoholic filtrate was evaporated to a very small bulk, filtered and allowed to cool. After standing some time crystals of leucine and tyrosin were found upon microscopic examination, while the fluid also gave Hoffman's test for tyrosin.

At another time a set of parallel experiments was carried on in which equal amounts, by weight, of egg albumen were allowed to digest for an equal time with the same amounts of water extract of the glands, but under different circumstances.

Two portions were digested in a medium of 1 per cent. sodium carbonate and sodium bi-carbonate, the one at a temperature of 37° C., the other at a temperature of 21° C. Two other portions were digested in a medium of 3 per cent. Ditman's sea-salt solution; one at 37° C., the other at 21° C. Still a fifth portion was digested in a medium of 0.2 per cent. hydrochloric acid at 37° C. All media were kept free from bacteria by the presence of thymol. The native and derived albumins were removed in each case in the same manner and then the fluids were all evaporated to the same small bulk, 200 cc. To each, 600 cc. strong alcohol were added, and the albumoses and peptones thus precipitated were collected upon balanced filter papers and weighed in order to determine the relative amounts formed in the different digestive processes. The results showed that digestion had gone on most rapidly in the medium of sodium carbonate and sodium bi-carbonate, and moreover that it had gone on in this medium at a temperature of 37° C. more rapidly than at 21° C. This same relation held in the case of digestion in the sea-salt medium, that being the more rapid which was allowed to go on at the higher temperature. In the case of digestion in the acid medium, scarcely any albumoses and peptones were formed, showing that in so weak an acid medium even as 0.2 per cent, digestion was greatly retarded.

II. Diastatic Ferment.

For this examination a dilute starch paste was made with 3 grams of starch to 200 cc. of water. To each of two portions of this paste was added an equal amount of fresh water extract of the pyloric cæca. Both were allowed to digest, one at a temperature of 37° C., the other at 21° C. Within fifteen minutes the substance digesting at 37° C. showed, upon testing with iodine, the port wine color peculiar to dexterine and also reduced the copper of Fehling's solution. Within half an hour these same reactions were produced in the portion of starch paste digesting at 21° C. Somewhat later both portions showed the presence of maltose in giving a negative test with iodine and a reduction of Fehling's solution. In this case, too, that portion which was digesting at the higher temperature showed the presence of maltose first.

The digestive process converted the starch no further than maltose, for even after digesting all night no test for glucose was obtained by Barfold's test (acidified copper acetate solution).

III. Fat-Splitting Ferment.

The presence of a fat-splitting ferment in the secretions of the pyloric cæca was proved by the fact that neutral olive oil, after being digested in the presence of thymol for same time, with a fresh neutral water extract of these cæca at a temperature of 37½° C., gave a decided acid reaction with litmus paper, thus showing that the neutral olein had been converted into free fatty acid and glycerine. A control portion of olive oil *alone*, which was submitted to the same digesting process under the same conditions, showed no acidity at the end of the experiment.

To sum up the conclusions that the results of the foregoing experiments seem to warrant, it seems that the pyloric cæca of the star-fish have no properties whatsoever—except, perhaps, their size and possibly color—which entitle them to a comparison with the liver of higher animals. On the contrary, however, they may be said to be closely related to the pancreas of the higher animals. Their secretion is abundant and contains three ferments :—

1. A Proteolytic ferment comparable to trypsin which acts best in a slightly alkaline medium, to good advantage in a neutral solution, but scarcely at all in an acid medium ; converting proteids into diffusible peptones and breaking down some of these even further into amido acids, as leucine and tyrosine.

II. A Diastatic ferment comparable to the diastatic enzyme of the pancreas which acts quite rapidly upon starch, converting it through the dextrines into maltose.

III. A Fat-splitting ferment comparable to that of the pancreas which breaks fats into their fatty acids and glycerine.

Upon these few but important and well-established facts it seems necessary, then, to abandon the old ground of characterizing the pyloric cæca of the star-fish as of unknown function, and to advance so far, at least, as to characterize them as important digestive glands, very similar in function to the pancreas of higher animals.

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EDITOR'S TABLE.

The confusion in the popular mind in regard to what biologists mean by "acquired character" is shown in a recent article by Prof. Cesare Lombroso,[1] and more strikingly in an editorial, apropos of this same article, which appeared a short time ago in the *Boston Medical and Surgical Journal.*[2]

Lombroso cites a number of cases which he regards as furnishing proof of the inheritance of acquired characteristics. In speaking of the development of the well known mental traits of the modern Hebrews he says: "Here we have a series of acquired psychical characteristics which have become heredity. This, no doubt, is due to some extent to climatic influences—transportation to colder countries—but more particularly to selection by persecution, as only by activity and the appearance of meanness and sordidness could the Hebrews have been saved from the fierce persecutions against which bold resistance would have been of no avail. It is this fact that made these vices prevail, and that caused the extinction, little by little, of those qualities—courage, generosity and boldness—that would have been more harmful than useful under the particular conditions." Again, in speaking of American traits of character, Lombroso says: "It happens because a race among the most robust of Europe has been transported to different surroundings; and the struggle for existence—rendered fiercer in the wilderness and among hostile tribes—if it served to destroy the weaker, gave room for the greater development of the strong, in whom qualities, perhaps already existent in the pacific Briton, but not yet unfolded for lack of occasion, emerged in the new adaptations required for new adventures." One might almost suppose these sentences to have been written by the most orthodox of neo-Darwinians. Nowhere in his paper does Lombroso offer any proof that the characteristics mentioned are not fortuitous variations. He takes it for granted that because a character is new and adaptive, that it is an acquired character become hereditary. There seems to be in his mind the very common confusion between the terms "new" and "acquired."

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[1] Lombroso, C.: The Heredity of Acquired Characteristics. *The Forum*, October, 1897, pp. 200–208.

[2] *Boston Medical and Surgical Journal*, October 21, 1897, Vol. 137, No. 17, p. 427.

The editor of the *Boston Medical and Surgical Journal* is suffering from a much worse confusion of the terms, for he has not yet learned to distinguish between infection and heredity. When the medical profession has demonstrated that syphilis is not an infectious disease, we shall be ready to accept congenital syphilis as an acquired character that has been inherited. Besides other cases of this kind, the editor cites the case of a child born of a mother who had taken from eight to fourteen grains of morphine daily, commencing soon after marriage. The three preceding children had died soon after birth. In this case the child, a ten pound girl, on the third day became sleepless, pale and prostrate, and five minutes later died. What possible bearing can a case like this have upon the question of the inheritance of acquired characters? Knowing the effect of morphine upon the adult, it is far from surprising that a child that had been bathed in and fed on morphine from the moment of conception until birth, should show some results of such treatment. We may have here an acquired character, but the evidence of inheritance is absolutely nil. It is a case of poisoning, not of inheritance.

The report of the proceedings of the Annual Meeting of the Boston Society of Natural History[3] has been lying upon our table for some time. We are glad to note that Prof. Hyatt has nearly completed the descriptive part of his work on the Achatinellinæ of the Hawaiian Islands. It is to be hoped that this very complete collection of land shells purchased by the Society in 1890 from the Rev. J. T. Gulick, will soon be placed on exhibition. It is one that will be of the greatest interest to all students of evolution.

It is annouced, also, that considerable progress has been made upon the collection illustrative of "dynamical zoology," and it is gratifying to know that it will be put in place during the present year.

[3] Proceedings Boston Society of Natural History, Vol. 28, No. 2, p. 45–72.

General Notes.

GENERAL BIOLOGY.

The average Contribution of each several Ancestor to the total Heritage of the Offspring.[1]—We inherit not only from our parents but also from our grandparents to remote generations. The problem is: What proportion of the whole is, on the average, inherited from each generation?

In an earlier work, Galton, as a result of experiments on sweet peas, reached the conclusion that 50 per cent. of our qualities are on the average derived from our two parents, and he suggested the probability that 25 per cent. comes from our four grandparents, 12.5 per cent. from all our great-grand-parents, and so on, the sum being 100 per cent. thus accounting for the whole inheritance. The present paper brings the required proof of Galton's hypothesis.

The method of proof is noteworthy. Galton had access to pedigree records of 'Basset' hounds bred through twenty years. These exhibited only two color types—tricolor (T) and non-tricolor (N). There were 817 hounds of known color derived from parents of known color: 567 of these had all four grandparents of known color; and 188, all great-parents. Galton determined, for example, whether the proportion of T-progeny of a known ancestry corresponds to the law of contribution enunciated above. He separated the progeny into three lots; namely, those which have 2 T-parents, 1 T-parent or 0 T-parent; each of these may be subdivided into lots having 4, 3, 2, or 1 T-grandparent. Do the percentages of T-progeny in these lots accord with what we might calculate from the law? Let us take a case; there are 119 individuals which have 2 T-parents and 3 T-grandparents. What per cent. should be tricolor? The two T-parents should each determine 25 per cent. total, 50 per cent. Each of the 3 T-grandparents should determine $\frac{1}{4} \times 25$ per cent., 6.25 per cent., total 18.75 per cent. together 68.75 per cent. To this must be added the influence of the T-great-grandparents and earlier ancestors. The probable percentage of unobserved T-ancestors and hence of T-generating influence may be calculated on the assumption that the percentage of T-parents producing T or N progeny will be the same for unknown as for known generations. By an extensive calculation, not necessary to reproduce here, Galton found that the totality of the ancestors of each T-grandparent determines the tricolor character of 4 per cent. of the progeny, and all the ancestors of each N-grandparent determines the T-characters of 2 per cent. of the progeny, so we must add to our sum 3×4 per cent.$=12$ per cent. for the 3 T-grandparents and 2 per cent. for the N-grandparent which gives the grand total of $68.7+12+2=83$ per cent. of the 119 progeny (or 99 individuals) which should be tricolor. As a matter of fact of the 119 individuals which had the ancestry in question 101 individuals were tricolor. Many comparisons between calculations and observations were made which agreed as well as this and thus confirmed the truth of the conclusion that we inherit on the average one-half of our qualities from our parents and half the remainder from each successive earlier generation of ancestors.—C. B. D.

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[1] Francis Galton: Proc. Royal Soc. lxi, p. 401–413, 1897.

Preformation vs. Epigenesis.—That the modern revival of the preformation—epigenesis controversy is resulting in a harmonious middle position through the application of the experimental method is a source of gratification as well to the believers in the application of this method to embryology as to those who desire the settlement of the dispute. Incidentally, however, these experiments are giving a clearer insight into the form-producing and form-maintaining factors. One of the latest contributions of this sort is that of Crampton who has described in the Annals of the New York Academy of Sciences, Volume X, experiments on isolated blastomeres of the Ascidian *Molgula manhattensis.* He finds that here, much as in the sea-urchin, the one-half blastomere undergoes a strictly partial cleavage, but rearrangements of blastomeres soon occur which tend to mask the partial nature of the development. Eventually a nearly complete larva of less than normal size and with defects in certain organs is produced. The missing half has been supplied by the cells already present. Thus there is here no pure epigenesis, no strict preformation, but a remarkable regulation phenomenon, as Driesch would say, by which the mutilated organism attempts, but not altogether successfully, to develop normally despite the unfavorable conditions.

Dissemination of organisms.—Experiments of Dr. Amedeo Berlese showing how insects and especially ants and some species of flies aid in the diffusion, preservation, and multiplication of yeasts, are described in a recent number of *Nature.*[1]

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[1] Nature, Oct. 14, 1897, pp. 575–577.

It is shown that yeasts not only may be carried in the digestive tract of flies (as well as upon the external parts of the body) but that they actually multiply there. The belief is expressed that many yeasts ordinarily pass the winter within the digestive tracts of insects, rather than upon the surfaces of plants or in the soil.

A Plankton Note.—Another illustration of the abundance of certain small animals in the ocean is furnished in a letter from W. A. Herdman published in *Nature.*[3] While crossing the Labrador current at about long. 50° W. in the steamship Parisian the party were served with a copepod stew. The little crustacea were caught by pumping the water into the ship and straining it through silk nets. In this way it was easy to obtain a sufficient number to make a "respectable dish."

MINERALOGY.

New Minerals. Derbylite.—Hussak and Prior[1] give a full description of a new antimono-titanate of iron, of which they had given a preliminary notice.[2] The mineral, named Derbylite in honor of the distinguished geologist of Brazil, O. A. Derby, occurs in the cinnabar-bearing sands of Tripuhay, Minas Geræs, Brazil, and has also been found in place in certain muscovite schists in the near vicinity. Derbylite is orthorhombic, $\breve{a} : \bar{b} : c = 0.96612 : 1 : 0.55025$. Twins on 011. Fracture parallel to 001 but no good cleavage. Crystals minute, color pitch-black, lustre resinous, hardness about 5, specific gravity 4.530. Optical properties undeterminable on account of opacity. Composition probably FeO, $Sb_2O_5 + 5$ FeO, TiO_2 neglecting small amounts of silica, alumina and alkalies.

Zirkelite.—Prior[3] gives a revised analysis of this new mineral[4]

ZrO_2	TiO_2	ThO_2	Ce_2O_3	(Y_2O_3?)	UO_2	FeO	CaO	MgO	Ignition	Sum
52.89	14.95	7.31	2.52	0.21	1.40	7.72	10.79	0.22	1.02	99.03

corresponding to the formula (approximately) RO.2 (Zr Ti Th) O_2.

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[3] Nature, Vol. 59, p. 565, Oct. 14, 1897.

[1] Min. Mag., Vol. XI, No. 52, p. 176.

[2] Min. Mag., Vol. XI, No. 50, p. 85.

[3] Min. Mag., Vol. XI, No 52, p. 180.

[4] First described in Min. Mag., Vol. XI, No. 50, p. 88. See abstract this journal, Vol. XXXI, July, 1897, p. 601.

Wellsite, a new Zeolite.—Pratt and Foote[5] describe a new mineral found in the Buck Creek Corundum Mine, Clay Co., N. C. They name it wellsite in honor of H. L. Wells, Prof. of Chemistry in Sheffield Scientific School. It occurs together with chabazite on albite, rarely also on hornblende and corundum, these minerals constituting a vein in a large mass of dunite near its contact with gneiss. Wellsite is monoclinic, forming doubly-twinned crystals like those of harmotome with pseudotetragonal aspect. Twinning planes are c, 001 and e, 011. Forms observed c, 001; a, 001; b, 010; m, 110; à : $\bar{b}$: c=0.768 : 1: 1.245 B=23° 27′. Cleavage none, lustre vitreous, colorless or white, hardness 4–4.5, specific gravity varying between 2.278 and 2.366 probably depending on differences in the ratio of barium to calcium in different crystals. Double refraction positive and weak. Plane of optic axes at right angles to 010, the obtuse bisectrix inclined 52° to c in the obtuse angle. 2 E probably between 120° and 130°. Chemical composition:

SiO_2	Al_2O_3	BaO	SrO	CaO	MgO	K_2O	Na_2O	H_2O	Sum
43.86	24.96	5.07	.1.15	5.80	0.62	3.40	1.80	13.35	100.01

corresponding to the formula R $Al_2Si_3O_{10}.3H_2O$. R contains BaO : CaO : (Na_2O+K_2O) in the ratio of 1 : 3 : 2. It was found that the water appeared to be in three conditions in the molecule, one-third being given off between 100° and 200°, another third between 200° and 300°, and the remaining third only at a red heat. The relations of wellsite to the phillipsite group of the zeolites is shown in the following table:

		à : $\bar{b}$: c	β
Wellsite	$RA1_2Si_3O_{10}$ .3 HO.	0.768 : 1 : 1.245	53 27
Phillipsite . . .	$RA1_2Si_4O_{12}$ .4½ H_2O	0·70949 : 1 : 1.2563	55 37
Harmotome . .	$RA1_2Si_5O_{14}$ .5 H_2O	0.70315 : 1 : 1.2310	55 10
Stilbite	$RA1_2Si_6O_{16}$ .6 H_2O	0.76227 : 1 : 1940	50 49

The authors predict the probable occurrence of a fifth member of the group corresponding to a hydrated anorthite which would have the composition $RA1_2Si_2O_8$ ·2 H_2O.

Silicate containing lead.—Penfield and Foote[6] describe a new mineral from the Franklin, New Jersey, zinc deposits to which they give the name roeblingite in honor of Mr. W. A. Roebling, the distinguished engineer of Trenton, N. J. Roeblingite occurs at the one thousand foot level of the Parker shaft of the N. J. Zinc Company, on or near the contact between granite and white limestone. There are many minerals in the immediate vicinity especially garnet and axinite, in the cavities of which it is generally is found. It forms dense, white, compact masses consisting of an aggregate of minute prismatic crystals which were doubly refracting but whose crystal system could not be determined. Specific gravity 3.433, hardness a little less than 3. Chemical composition :

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[5] Am. J. Sci., Vol CLIII, 1897, p. 443.

[6] Am. J. Sci., Vol. CLIII, 1897, p. 413.

SiO_2	SO_2	PbO	MnO	CaO	SrO	K_2O	Na_2O	H_2O	Sum
23.66	9.00	31.03	2.48	25.95	1.40	0.13	0.40	6.36	100.32

corresponding to the complicated formula $H_{10}Ca_7Pb_2Si_5S_2O_{28}$, the small amounts of MnO, SrO and alkalies being united with the calcium. This is equivalent to $5H_2CaSiO_4+2CaPbSO_4$. This adds one to the small list of silicates containing lead and is the first observed occurrence of a sulphite in nature. Pyrognostics: fuses at 3 to a globule, giving blue lead flame and with soda a lead coating; Mn reaction; soluble in weak acids with separation of gelatinous silica.

Bixbyite.—Penfield and Foote[7] describe a new mineral from the topaz locality in the mountains, thirty-five miles southwest of Simpson, Utah. The crystals are implanted upon topaz and altered garnet and rhyolite and are evidently a product of fumarole action.

Bixbyite is isometric, crystallizing in cubes sometimes modified by the icositetrahedron, 112, the crystals being upwards of 5 mm. on the edge. Irregular fracture with traces of octahedral cleavage, color brilliant black with metallic lustre, streak black; hardness 6–6.5, specific gravity 4.945. Fuses at 4 and becomes magnetic; powder dissolves with difficulty in HCl, liberating chlorine. The analysis (by Foote) showed the following composition :

SiO_2	Al_2O_3	Fe_2O_3	TiO_2	MnO	MgO	O	Sum
1.21	2.53	47.98	1.70	42.05	0.10	4.38	99.95.

The silica and alumina are regarded as due to a small amount of topaz which could not be separated. The composition may then be expressed as R_2O_3 where R is Fe, Mn, and a little Ti. But other considerations, especially its isometric form, point rather to the formula $RO.RO_2$ or $FeO.MnO_2$ with small amounts of MgO and MnO replacing FeO, and TiO_2 replacing MnO_2. It thus corresponds closely to braunite, $MnO.MnO_2$ and to the isometric perofskite, $CaO.TiO_2$. The name is in honor of Mr. Maynard Bixby of Salt Lake City, who first brought the mineral to notice.

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[7] Am. J. Sci., Vol. CLIV, 1897, p. 105.

Associated with the bixbyite are topaz crystals showing combinations of the following forms:

a, 100; c, 001; m, 110; l, 120; d, 201; f. 021; y, 041; o, 221; u, 111.

There are also rough pseudomorph crystals, probably after the manganese garnet, spessartine, now composed of a mixture of bixbyite with either topaz or quartz or both.

Zinkenite Group.—Spencer[8] describes a twin crystal of chalcostibite (wolfsbergite) from Wolfsberg with 102 as twin plane, not before observed. Also (rare) simple crystals of zinkenite from the same place showing the new form 001. He then shows that by a proper orientation of the crystals of these two minerals the similarity in habit, striation, and twinning may be shown and also their place in the isomorphic zinkenite group as follows:

		$\breve{a} : \bar{b} : c$
Zinkenite . .	$PbS.Sb_2S_3$.	0.5575 : 1 : 0.6353
Wolfsburgite	$Cu_2S.Sb_2S_5$	0.5312 : 1 : 0.6376
(Chalcostibite, Penfield)		0.5312 : 1 : 0.63955
Sartorite	$Pb S.As_2S_3$	0.5389 : 1 : 0.6188
Emplectite	$Cu_2S.Bi_2S_3$	0.5430 : 1 : 0.6256

He states on the ground of crystallographic measurements that probably the mineral guejarite described by Cumenge as having the composition $Cu_2\ S.2Sb_2S_3$ will be found to be identical with chalcostibite. This has been proved by Penfield and Frenzel[9] by a re examination of material from Guejar and a study of new material from Huanchaca, Bolivia, supposed to be guejarite. Measurements of crystals from these two localities gave results entirely agreeing wlth those from typical chalcostibite from Wolfsburg. The chemical constitution of the minerals from the three localities was also shown to be identical, and to satisfy the chalcostibite formula: $Cu_2S.Sb_2S_3$. On the chalcostibite from Huanchaca Penfield observed 20 forms of which 13 were new as follows: 130, 209, 207, 205, 203, 302, 065, 136, 133, 265, 263, 261, 4.12.5. He also shows that the forms observed by Laspeyres, 7.14.8, and 7.21.27, should be 6.12.7, and 134 respectively. In Penfield's paper is further a description by Spencer of a chalcostibite specimen in the British Museum, likewise from Huanchaca, on which were the further new forms: 233, 354, 474, 475, 476.

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[8] Min. Mag., Vol XI, No. 52, p. 188.

[9] An. J. Sci., Vol. CLIV, 1897, p. 27.

The axial ratio adopted is $\breve{a} : \bar{b} : c := 0.5312 : 1 : 0.6395$, and elaborate tables of angles show the thorough agreement of the observations on which is based the identity of guejarite and chalcostibite.

Terrestrial Iron from Missouri.—Allen[10] describes three occurrences of native iron, considered to be of undoubted terrestrial origin, in the Coal Measures of Missouri. In each case the iron was found during the drilling of a well; at Cameron, Clinton Co. the iron formed a mass several inches in thickness in the midst of a solid sandstone, fifty-one feet below the surface; at Weaubleau, Hickory Co. a few pieces of iron were found in a stratum of gray clay, interbedded with sandstone and thin seams of lignite at the depth of thirty-five feet; at Holden, Johnson Co. a mass of iron was struck but not passed through, in a bed of fireclay, underlying an eighteen-inch coal-seam, thirty-seven feet below the surface.

The character of the iron was the same in all the occurrences. It was free from rust, of a lustrous silvery white color, very malleable, hardness 3, specific gravity varying from 7.43 to 7.88. The largest piece obtained weighed 45.4 grams. Some pieces exhibited a layered structure almost amounting to a cleavage. Polished surfaces, etched, showed no Widmanstätten figures. The chemical composition of the iron was nearly the same in the three localities:

	I	II	III
Fe	99.16	99.39	97.10
SiO_2	0.87	0.31	1.65
P	0.207	0.13	0.176
C	0.065	undet'd	undet'd
	99.802	99.83	98.926

The writer appears to consider that these irons represent cases of local reduction, the association with coal or coal-bearing strata being held as significant. It seems worthy of note in this regard that the amount of carbon, both in the irons and in the rocks in which they were situated, was very small.

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[10] Am. J. Sci., Vol. CLIV, 1897, p. 99.

PETROGRAPHY.[1]

Petrography of the Marquette Iron Range.—Van Hise and Bayley[2] in their recent description of the Marquette Iron Range in Michigan, give accounts of the petrography of the Archean and of the Algonkian rocks occurring in the region. The pre-Algonkian rocks comprise granite-gneisses, syenites, hornblendic and micaceous schists, and a series of green schists that are cut by peridotites, and by acid and basic dykes. The granites or gneisses are notable for the large quantity of microcline they contain. Although this is present in the most massive phases of the granite, it is much more abundant in those phases that are schistose as the result of pressure. These rocks are much crushed, and have developed in them great quantities of new plagioclase, quartz and muscovite in addition to the microcline above referred to. The syenites are mainly granitic aggregates of orthoclase and hornblende, with some plagioclase and a number of secondary products formed under the influence of pressure. These are the same in character as the secondary products formed in the granite under similar conditions. The green schists are squeezed surface materials. Some of them are squeezed tuffs and others squeezed lavas. The former contain numerous pebble-like masses that are taken to be bombs and rounded lava fragments. The present constituents of the schists are chlorite, sericite, calcite, plagioclase, quartz and sometimes epidote. Much of the plagioclase is in broken crystals lying in a matrix formed of smaller fragments of the same mineral cemented together by a felt of the others in a very finely crystallized groundmass. The structure of many of the schists is typically tuffaceous. These rocks indicate clearly the existence of volcanoes in pre-Algonkian time. The basic schists are associated with acid ones that seem to be squeezed rhyolitic lavas. Analyses of these two classes of schists follow :

	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	CaO	MgO	K_2O	Na_2O	P_2O_5	CO_2	H_2O	Total
Basic schist	61.35	.26	16.45	.94	4.20	3.46	3.12	1.05	5.24	.18	1.98	2.61	= 100.84
Acid schist	70.76	.33	14.83	1.46	3.09	.36	1.99	3.50	.47	.26		2.79	= 99.84

The basic rocks cutting the gneisses and schists are diabases in various stages of alteration, and the acid ones are quartz porphyries. These have been carefully described by Williams.[3] The peridotite of the Marquette district was carefully described years ago by Wadsworth. The only additional fact of importance added by the authors with respect to this rock concerns its composition. An analysis of a very fresh specimen gave:

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[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Monograph XXVIII U. S. Geol. Survey, Washington, 1897.

SiO_2	TiO_2	Al_2O_3	Cr_2O_3	Fe_2O_3	FeO	MnO	NiO	CaO	SrO	BaO	MgO	K_2O	Na_2O	CO_2	P_2O_5	H_2O	Total
39.37	.66	4.47	.68	4.96	9.13	.12	.21	3.70	tr	tr	26.53	.26	.50	1.23	.17	7.95	= 99 94

A few hornblende-schists met with in certain portions of the area studied are shown to be altered igneous rocks, possibly recrystallized lavas.

The micaceous schists are well banded rocks with a distinct dip and strike. They are often interlaminated with thin bands of hornblende-schists with which they are perfectly conformable. These micaceous schists embrace muscovite-schists, biotite-schists and feldspathic biotite-schists, most of which are so much decomposed that their original composition is difficult to determine. It is probable that they are crystallized acid lavas or tuffs.

In the Algonkian series are quartzites, conglomerates, graywackes, slates, dolomites, grünerite-magnetite schists, jaspilites, mica-schists and a series of basic tuffs that have suffered metamorphism until they are now largely hornblende-biotite-schists. The production of hornblende in these tuffs is on a very extensive scale. The amphibole is in large plates that are more or less idiomorphic, and nearly all of these are cellular in structure. The greenstones that are intrusive in the iron formation are altered diabases, in only a few of which augite can still be detected. These rocks have heretofore been generally known as diorites. In the western part of the district where the squeezing has been more intense than elsewhere much quartz and biotite has been developed in them, and the rocks present a very different aspect from the more normal phases.

All the rocks mentioned above are described in detail, and many colored reproductions of polished hand specimens of limestones, slate and jaspilite illustrate the report.

The Rock-formation of the Silver Cliff and Rosita Hills District, Colorado.—The mines of the Silver Creek and Rosita district are mainly in volcanic rocks. The eastern portion of the area is the seat of an old volcano which erupted andesite, rhyolites and trachytes both in lava and in tuff form. These constitute the Rosita Hills. North and east of these are the old granites and gneisses. In the

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[3] Bull. 62 U. S. Geol. Survey.

neighborhood of Silver Cliff only the rhyolites are present. The granites intrude the gneisses, both being early Cambrian or pre-Cambrian. The volcanic series dates from the early Eocene; in this and in some other respects being like similar rocks at Cripple Creek and at other volcanic centres in the State. Both the Rosita and the Cripple Creek volcanoes are regarded as small outlying vents connected in origin with the much larger eruptions of the San Juan and South Park regions.

The gneisses of the Silver Cliff-Rosita Hills district are described by Cross[4] as variable in composition, no one type persisting over any great area. They consist of microcline, orthoclase, quartz and biotite, muscovite, hornblende or augite, and by variation in the amounts of either one or several of these constituents they grade into quite different types. The quartz and the bisilicates are often segregated in thin layers or streaks, thus giving the gneiss a banded aspect. Among the principal types represented in the complex, the augite-hornblende-gneiss is the most definite. It is a basic gneiss composed of a basic plagioclase and numerous intergrowths of augite and hornblende. The old gneisses and granites are cut by dykes of syenite, diabase and peridotite.[5]

The earliest member of the volcanic series is a hornblende-mica-andesite which occurs principally as a tuff. This was followed by massive effusions of an augite-biotite-andesite containing large phenocrysts of orthoclase and small crystals of plagioclase surrounded by orthoclase rims. The andesites are cut by dykes of an augite-diorite containing biotite and altered olivine, and in some facies of the rock considerable orthoclase.

A later lava than the andesite was the dacite, which differs from the augite-andesite in the presence of quartz and in the subordination of the dark silicate to the feldspars. Orthoclase is absent from the dacites, and the plagioclases present are nearly all andesine.

The next in age and the most abundant of the lavas are rhyolites. These vary greatly in character, but nearly all phases are devoid of dark silicates. They occur in massive and in banded ledges, and in others remarkable for the great abundance in them of very large spherulites. These have been carefully studied by the author and reported upon in another place. In addition to the lavas tuffs, agglomerates and other evidences of explosive volcanic activity are noted in the vicinity of Rosita. Following the rhyolite came another biotite-augite-andesite, and finally a trachyte of normal character.

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[4] 17th Ann. Rep. U. S. Geol. Survey, p. 269.

[5] Cf. Proc. Colorado Sci. Soc., Vol. II, 1887, p. 223.

One of the most interesting rocks of the district is the Bassick Mine agglomerate made up of fragments of many different rocks cemented by fine debris of the same character. This is now usually so much decomposed that its original constituents can in many cases no longer be recognized.

In addition to the volcanic rocks mentioned above, a mica-dacite and a limburgite were observed. They are, however, quite rare. All the volcanic rocks have been decomposed by solfataric action, yielding products of various kinds, the two most important of which are a white siliceous clay resulting from the alteration of pitchstone and a quartz alunite rock produced from rhyolite. Analyses of the pitchstone and its alteration product follow:

	SiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	K_2O	Na_2O	H_2O	Total
Pitchstone	71.56	13.10	.66	.28	.16	.74	.14	4.06	3.77	5.52 =	99.99
Clay	71.71	12.36	1.10		.17	1.11	1.21	.36	.17	11.97 =	100.16

The andesite is often muscovitized, all of its constituents but augite and orthoclase passing over into aggregates of muscovite apparently with great ease.

The report closes with a discussion of differentiation in which the author does not reach any definite conclusions, except that in the case of the Rosita rocks much of the differentiation which resulted in the different phases of the various types must have taken place either after the lavas had reached their present position, or at any rate at no great depth under the surface.

Notes.—Wolff[1] gives a description and a map of the exposures of eruptive rocks occurring in Sussex Co., N. Y. These exposures include those of the well known eleolite-syenite and associated dyke rocks at Beemerville.

PALÆONTOLOGY.

Schuchert's Synopsis of American Fossil Brachiopoda.[2]—Students of Brachiopoda, as well as Mr. Schuchert, are to be congratulated upon the publication of this important work. Its preparation has extended over a period of eleven years, and entailed references and cross references to upwards of 2,500 species, necessitating about 10,000 citations. All the literature relating to North and South American fossil Brachiopods is recorded in this synopsis, and 2,053 valid species are recognized, of which 1,922 are North American, and 1,859 are restricted to the Paleozoic. It is estimated that 6,000 Paleozoic species have been described for the whole world; therefore about one-third of the number occur in North America.

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[1] Ann. Rep. State Geol. of New Jersey for 1896, p. 91.

[2] A Synopsis of American Fossil Brachiopoda, including Bibliography and Synonymy. By Charles Schuchert, Bulletin U. S. Geol. Survey, No. 87. 8°, 464 pp., Washington, 1897.

In the American Mesozoic, a marked scarcity of Brachiopods exists, since but 49 species have been recorded, and many of these are rare. The Cenozoic representation is even smaller, there being but 14 species. In the North American Cambrian, there are 116 known species, with 319 in the Ordovician, 311 in the Silurian, 662 in the Devonian, while the Carboniferous representation declines to 478. In America, the class practically became extinct with the close of the Paleozoic, for but 11 species are known from the Triassic and 13 from the Jurassic. During the Ordovician, the increase was extremely rapid and all the essential types occur near the base of the system in the Calciferous. The culmination of the class was attained during the Devonian.

Under the geographic distribution of Brachiopods, it is stated that 537 species had great areal or horizontal dispersion, and 121 species are common to North America and other continents. The specific distribution increases with ordinal rank, so that while 25 per cent of the Atremata had dispersion, the Neotremata show 27 per cent; and the higher orders, the Protremata and Telotremata, each show 32 per cent. The order Atremata is best developed in species and genera in the Cambrian and Ordovician systems; the Neotremata in the Ordovician; the Protremata in the Ordovician, Silurian, and Devonian; and the Telotremata in the Devonian. The climax of differentiation is, therefore, chronologically related to phylogenetic or sequential origin. But 8 genera are known to pass from the Paleozoic to the Mesozoic. There are in all 327 Brachiopod genera, 227 of which are Paleozoic.

After the discussion and tables illustrating the geologic development and geographic distribution of the American fossil forms, the author presents a chapter on Brachiopod terminology, in which all the current descriptive terms are defined. The biologic development is then taken up in detail for the separate orders and for special important features, as the protegulum, prodeltidium, cardinal areas, articulation, deltidium, spondylium, etc. The morphology of the brachia is discussed in a separate chapter prepared for this work by C. E. Beecher.

The various schemes of classification applied to the Brachiopods are taken up chronologically, and the strong and weak points of each are critically reviewed. The author then enunciates the principles of a classification based on the history of the class and the ontogeny of the individual. The ordinal grouping proposed by Beecher in 1891 is the only one for the Brachiopods which is founded upon these principles, and is therefore adopted. Schuchert has greatly elaborated and developed the classification along these lines until it is now very complete and satisfactory.

The orders are based mainly upon the nature of the pedicle opening; superfamilies upon the persistent internal characters of the shell; and families within the superfamilies upon a combination of common external and internal generic characters. The generic limitations and the disposal of species are largely in accordance with the work of Hall and Clarke.

The final chapter containing the index and bibliography necessarily constitutes the bulk of the work. The arrangement is alphabetical and will greatly facilitate references to any species or genus. The plan of treatment is as follows: The generic name and author are first given, and also the genotype, or type species of the genus, together with references to all the literature. Then follow the species under the genus, each with its geological distribution, references and synonymy, geographical position, and in many cases, observations on the synonymy, structure, and affinities.—C. E. B.

BOTANY.

Bailey's Principles of Fruit Growing.[1]—This volume of the Rural Science Series, which is issuing under the editorial management of Professor Bailey, contains only eight chapters, but goes into an unusual amount of detail in the discussion of all phases of fruit-growing, from the primary location of the fruit farm to the handling and marketing of its produce. Few problems are as complicated as those underlying the art of horticulture, and the author has done well in analyzing them quite fully, for there is little doubt that intelligent observation in any locality can supply better data for local practice than can be laid down empirically in the best book. Though a rather curiously classified inventory of fruits occupies the early pages, the discussion of practical details is chiefly limited to the varieties growing in the temperate part of the United States.—T.

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[1] The principles of fruit-growing. By L. H. Bailey, New York. The Macmillan Company, 1897, pp. xi+508. $1.25.

EMBRYOLOGY.[1]

Fertilization.—Our present conceptions of the meaning and of the cell factors concerned in the act of fertilization have been based so largely upon the views of Boveri and these arose so directly from the study of the eggs of *Ascaris megalocephala* that it is of the greatest importance to know how far we rest assured in the knowledge of the truth in this classical object.

The well-known editor of LA CELLULE has with M. H. Labrun restudied fertilization in this worm and obtained facts quite at variance with those commonly accepted. Professor Carnoy studies sections that are obtained after killing the eggs with a mixture of absolute alcohol, chloroform and acetic acid saturated with corrosive sublimate and this certainly yields most beautiful pictures of reticular appearances throughout cell and nucleus.

While Boveri regarded the introduction of a centrosome by the sperm as a most important part of fertilization Carnoy denies that there is any such fact. For Boveri, the sexes are not alike since the egg has no centrosome to start the process of fertilization and the sperm has such a centre. For Carnoy, there is entire equality of the sexes since both sperm and egg each furnish a centrosome for the first cleavage and in every other way the fertilized egg is a combination of the same elements from both sexes.

A cardinal point in Carnoy's observations is the fact, as claimed, that the nucleoli pass out from the nuclei and become the centrosomes! The centrosomes also vanish after each cleavage and *do not divide* to make new ones!

A summarization of his facts includes the following assertions: 1. At the last division of the series of cells that form eggs, the centrosome vanishes from the protoplasm and new ones are formed in the nucleus of the unripe egg. 2. In the formation of the polar bodies these centrosomes emerge from the nucleus and function; perhaps they disappear after the first, and are formed again for the second, polar body. 3. Both polar bodies are formed with the presence of centrosome and asters; but these structures then disappear and there is no centre left in the protoplasm of the ripe egg. 4. The sperm introduces a large mass of reticulum and this acts upon the reticulum of the egg to produce a radiating change that gradually works over and modifies the entire egg. Boveri's *archoplasm* does not exist except as this radiating area of influence. 5. In this radiating mass there is no centrosome, no sperm centre—nothing but a mass of nucleo-albuminiferous enchylema discharged from the sperm and in process of solution. 6. Up to the time of cleavage there are no centrosomes in the protoplasm and there can be no "quadrille of the centres." 7. The centrosomes arise early in the pronuclei, one in each, as nucleoli. 8. One centrosome comes out of the sperm nucleus and one out of the egg and they function as soon as they get into the eggs protoplasm, to form asters. 9. The spindle is made from the network of the nucleus, (fused sperm and egg nuclei), under the influence of the centrosomes. 10. The centrosomes do not divide but dissolve; the asters also disappear without dividing. 11. In each new nucleus two new nucleoli arise and after a dormant period pass out to function as centrosomes in the next cleavage.

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[1] Edited by E. A. Andrews, Baltimore, Md., to whom abstracts, reviews and preliminary notes may be sent.

Fertilization is thus a most complex process in which two individuals of different origin merge into one new entity of mixed nature; mixed not only in chromosomes but in all parts; cytoplasm, caryoplasm, centrosomes, all of double origin, male and female.

The egg may transmit the properties of both parents since it acts as a mixed being of double origin in all parts, throughout cleavage and subsequently. The entire egg not only the nucleus but also the outer protoplasm may be concerned in heredity.

As life remains a complex of mysterious and unexplained phenomena the author deems it folly to venture hypotheses as to the nature of heredity. "Sachons avouer notre ignorance profonde et nous arrêter à la limite de notre modeste savoir."

PSYCHOLOGY.[1]

The Physical Basis of Pain.—The unsettled state of opinion among psychologists in regard to the nature of pain was touched upon last year in these notes.[2] The chief points at issue are whether pain and pleasure should be classed as sensations or as affective elements of consciousness, and how far a distinction should be drawn between so-called physical pain (Schmerz) and pain in the sense of displeasure (Unlust). The older theories in general regarded pain solely as a feeling, without any distinct physiological basis at all. The use of a single term in English for both Schmerz and Unlust has tended to obscure their difference, but recent discussion has brought it out with greater distinctness, and many writers now regard pain—at least when it involves some definite locality, as in the case of head-ache, tooth-ache, pricking, etc.—as a real sensation.

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[1] Edited by Howard C. Warren, Princeton University, Princton, N. J.

[2] November, 1896, p. 948.

Attempts have been made, in connection with this view, to discover definite end-organs and nerve tracts for the pain sense. The probability of the existence of such a physical basis has lately been urged with great force by a number of writers, on the evidence furnished by certain pathological cases, where localized hyperalgesia or analgesia occur without any marked alteration in the senses of pressure or temperature. They argue that if pain can be heightened or deadened without disturbance of the other dermal senses, it must be furnished with a distinct sensory apparatus of its own. Numerous clinical cases, reported by Dr. Henry Head in a series of articles in "Brain,"[3] lend considerable support to this view. These observations and others have been regarded as direct evidence that pain has a distinctive anatomical and physiological basis—either a complete set of end-organs and nerve apparatus, or at least a separate conducting tract and cortical center. Several objections have been raised against the more radical view, the chief being that no type of end-organ has been found in the skin, apart from those required for the senses of pressure and temperature.

A recent paper by Prof. Witmer, of Pennsylvania, reported at the British Association this summer and since published,[4] recognizes the force of this criticism, and favors the modified view of a spinal tract and center for pain. Prof. Witmer reviews the clinical and experimental evidence in great detail, taking up the parts of the sensory apparatus separately.

"There is no conclusive anatomical evidence," he says, "for the existence of a peripheral sense organ or nervous end organ for pain. There is no conclusive evidence for the existence of peripheral pain nerves or peripheral sensory neurons. Much evidence justifies the conclusion that all or some peripheral nerves may, under adequate stimulation, act with specific pain-producing function; that such nerves may lose this function without a loss of other functions or may lose their other specialized sensory functions without losing the pain function. Local peripheral analgesia and analgesia due to compression or

[3] Vols. XVI, p. 1; XVII, p. 339, and XIX, p. 153.

[4] Twentieth Century Practice of Medicine, 1897, XI, p. 905.

disease of the peripheral sensory neuron make the assumption of peripheral pain nerves and sense organs one that stands closely related to the facts.

"There is a specialized pain tract in the spinal cord which is certainly constituted in part by the gray column, and which may be composed of a part of the gray column on both sides, including the commissure and a part of the lateral tract. Into this pain tract, nerves from the sympathetic system and from the internal organs, together with all specialized nerves from the periphery, discharge their stimulation when this is relatively intense. The intensity necessary to bring about this discharge may be that which is sufficient to overcome the resistance offered by the tract. This tract passes up through the optic thalamus and posterior limb of the internal capsule, the 'carrefour sensitif,' into the cerebrum, and reaches some region unknown, but probably a part of the somæsthetic area. This hypothetical region of the somæsthetic area may be looked upon as the pain centre.

"There is some warrant of justification for considering the pain tract in the spinal cord as the spinal nerve organ of pain, which, together with the hypothetical specialized cortical centre, constitutes the specific organ of pain. Any part of this central pain organ may be stimulated in the cortex or below it, either by stimuli discharging into it through normal physiological processes, by spinal or cortical association, by irritation due to disease, and perhaps by a vascular disturbance within the central nervous system.

"Thus pain may be a sensation of purely central nervous origin. The arousal of pain by stimuli and its presentation in consciousness along with other sensations may be explained by the simultaneous association of pain with other forms of stimulation—an association that may take place at any level of the nervous system. When such association takes place in the cortex, we have conscious association, the connection of pain with other sensations, with percepts, or with ideas." * * * * The universality of pain association with sensations of maximal intensity is explainable anatomically and physiologically by the discharge of intense stimuli carried by all peripheral nerves into the central pain organ: that this central pain organ has no peripheral nerves of its own, possessing a specific pain function and no other, can receive satisfactory explanation only from biological considerations of the significance of pain as a warning against dangerous stimuli of the environment. This fact would suggest an early phylogenetic development of a pain sense in the organism; in fact, the pain sense may have been the first of all the special senses."[5]

[5] Op. cit., pp. 940–941.

If this analysis be accepted, it will naturally follow that pain must be regarded as a sensation alongside of the sensations of pressure, temperature, etc., but differing from them in having no specific end-organ, and depending upon them for its stimulation. It is scarcely necessary, then, to turn to introspection for further evidence. Prof. Witmer says: "Pain is a simple, unanalyzable mental content. It should therefore be called a sensation." The advocates of a dual or triple divison of the elementary data of consciousness will, of course, deny this argument *ab initio*. But the physiological evidence is another matter, and the hypothesis is sufficiently well grounded to call for careful consideration and discussion.—H. C. W.

Baldwin's Social and Ethical Interpretations in Mental Development.[6]—Following up the line of thought of his earlier work, on "Mental Development in the Child and the Race," Prof. Baldwin, in the present volume, considers the social aspects of that development. The connection between the individual and society he believes to be very close. On the one hand the mental growth of the individual is more or less controlled by conditions in the social environment; on the other hand, the forms of organization. growth and activity of society are analogous to those of the individual organism. Prof. Baldwin examines both of these relations in turn. The development of the notion of Self in the child proceeds *pari passu* with the rise of the notion of Other. The social environment furnishes him with a vast store of traditions and customs (social heredity) which form an important factor in his mental life; this same environment supports him where he conforms to its standards, and "suppresses" him where he does not. The inventive function, too—that by which the individual arrives at new results, different from his mere imitations of others—is guided by social approval and disapproval. In all these phases of individual growth the social environment supplements the instincts and other endowments derived from biological and psychological heredity. The author concludes this part of his work with an analysis of the elements in man's mental constitution which fit him for the social relation (sympathy, social intelligence, ethical sentiment, etc.), and a comparison of the sanctions, personal and social, which determine his acts.

In taking up the problem from the standpoint of the social organization, the author considers (1) the forces which control society, (2) the material and process of social organization, and (3) the nature of social progress. As regards the first question, he finds two distinct influences at work in society; the individual is a *particularizing* force, while the social organization itself tends in the direction of *generalization.* The *matter* of society consists, he says, of "intellectual states, such as imaginations, knowledges and informations." These "originate in the mind of the individuals of the group, as inventions, more or less novel conceptions, what we have called 'particularizations.' At their origin there is no reason for calling them social matter, since they are particular to the individual. They become social only when society—that is, the other members of the social group, or some of them—also thinks them, knows them, is informed of them. This reduces them, from the individual and particular form to a general or social form, and it is only in this form that they furnish social material, through what has been called, again, the 'generalization' effected by society" (pp. 487–8). The *process* of organization is through imitation: the individual particularizes in his exercise of imitation; society, by imitating the thoughts of particular individuals, generalizes them.

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[6] Social and Ethical Interpretations in Mental Development. By James Mark Baldwin. New York: The Macmillan Co., 1897, pp. xiv, 574, $2.60.

SELECTION.[1]

SORT.	MEANS.	RESULT.
1, 2. Natural Selection: I. (Darwin, Wallace, Spencer) [40].	1. Struggle for Existence (Darwin, Wallace).	1. "Survival of the Fittest" Individuals (Spencer).
II. (Eimer) [40].	2. Inherent Weakness, without Struggle.	2. Destruction of Unfit Individuals.
3. Germinal Selection (Weismann).	3 Struggle of Germinal Elements.	3. Survival of Fittest Germinal Elements.
4. Intra-Selection (Roux, Weismann, Delage).	4. Struggle of Parts (Roux).	4. Survival of Fittest Organs.
5. Functional Selection (Baldwin).	5. Overproduction of Movements, (Bain, Spencer, Baldwin).	5. Survival of Fittest Functions.
6. Organic Selection (Baldwin, Osborn, Lloyd Morgan) [Appendix A].	6. Accommodation (Baldwin); Individual Adaptation (Osborn); Modification (Lloyd Morgan).	6. Survival of Accommodating Individuals.
7. Artificial Selection (Darwin).	7. Choice for Planting and for Mating Together.	7. Reproductions of Desirable Individuals.
8. Personal Selection[2] [40].	8. Choice.	8. Employment and Survival of Socially Available Individuals.
9. Sexual Selection (Darwin) [40].	9. Conscious Selection by Courting, etc.	9. Reproduction of Attractive Individuals.
10. Social Selection[2] [40, 120].	10. Social Competition of Individuals and Groups with Natural Selection (Malthus, Darwin).	10. Survival of Socially Fittest Individuals and Groups.
11. Social Suppression[2] [38 ff.].	11. Suppression of Socially Unfittest (by Law, Custom, etc.).	11. Survival of Socially Fit.
12. Imitative Selection[2] [40, 121, 307]. Social Generalization[2] [121, 310 ff.].	12. Imitative Propagation from Mind to Mind with Social Heredity.	12. Survival of Ideas.

[1] I am indebted to Professor Lloyd Morgan for several suggestions utilized in the Table.

[2] Suggested in this work.

The *progress* of society is, in its method, direction and impelling motives, "analogous to the growth of consciousness rather than to that of the biological organism;" hence Prof. Baldwin objects to the application of the term *organism* to society, and prefers *organization*.

It would be impossible here to enter into any more minute examination or criticism of the positions maintained in this work. Attention should be called, however, to Prof. Baldwin's classification of the various sorts of developmental "Selection." The accompanying table, reproduced from Appendix B of the book, shows a number of distinct types, together with the authors who have discovered or elaborated them. The arrangement begins with the purely biological agencies, and proceeds up through the psychological to the social. The table furnishes a valuable contribution to evolution literature; the distinction drawn between the means, the result, and the name given to the process itself, clears up a number of points in regard to which considerable confusion has hitherto existed.—H. C. W.

ANTHROPOLOGY.

The History of Mankind.[1]—The second volume of the translation of Prof. Ratzel's "History" more than meets the expectations of students of ethnography and others who have awaited its appearance with no little interest. The "modern method" of treatment and the wealth of illustrations continue to be prominent and pleasing features.

"Book II" describes (1) The Cultured Races of America; (2) The Ancient Civilized Races of America; (3) The Arctic Races of the Old World. Book III, The Light Stocks of South and Central Africa. Book IV, The South and East Africans.

The American tribes are not considered in detail, but in culture groups as the Forest and Prairie Indians of North America, the Forest Indians of Central and South America, the Pategonians, the Fuegians, etc. No general treatise has heretofore so fully described the inhabitants of the southern portion of the South American Continent. Some of the prevailing stories regarding their utter wretchedness are contradicted, and we learn that "the Fuegians are, at the bottom, Indians like all the rest," and our estimate of their disposition and intellect increases with nearer acquaintance. Throughout the volume, attention, justly due but seldom paid, is given to that important factor of culture growth, geographical environment. The author describes the advantages offered by the flora and climate of temperate and tropical America, and briefly comments upon the disadvantage to the nascent civilizations of the absence of the larger domestic animals. Very little space is given to speculations regarding the origin of the American race. We are told that "there can be no doubt America possessed human inhabitants as early as the Age of the Drift, though the conflict as to Tertiary man is as far from being settled there as it is in Europe." The date of the workshop for the manufacture of chert-flakes, which was discovered in Minnesota, is accepted without question as "interglacial." The Trenton Ghost is not raised. The belief in the unity of the American race is based upon the ground of long isolation and consequent assimilation rather than upon community of descent. Virchow's statement is quoted with approval "that from the point of view of anthropological [somatological] classification there is no real unity among the aboriginal population of America," a typical American skull does not exist, "in every large burying-ground all lengths and shapes are represented."

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[1] *The History of Mankind.* By Professor Friedrich Ratzel. Translated from the second German edition by A. J. Butler, M. A., with introduction by E. B. Tylor, D. C. L., F. R. S., with colored plates, maps and illustrations. 1897, N. Y., Macmillan, Vol. II, pp. 562.

The Eskimos are connected with the Indians, "as it seems too hazardous to rank them with the true Monogoloids. But northeast Asia is unquestionably a region of transition which finds its continuation in northern America." We may hope that the results obtained by the Jesup expedition will have an important bearing upon this question. Notwithstanding the excellent authorities quoted we can scarcely admit that the stature of the Eskimo is "low," but are more inclined, after a journey through the entire region occupied by the "Western Eskimo" west of the Mackenzie, to agree with a recent paper by Mr. Murdoch, in which he states that they are of "medium height, while much taller men are far from uncommon." The Eskimo has been cleared of the charge of stuffing himself with raw meat and drinking quantities of train oil, but not so the reindeer—Chukchi, by whom "frozen fish is eaten raw; the head of a freshly-killed reindeer has also to be devored raw, and his liver, ears, and kidney-fat are regarded as tid-bits only when raw. Melted fat or butter is a favorite drink, and is consumed in quantities of several pounds." Among the Hyperboreans as among so many races in more favored climes, the withering influences of civilization are at work. "The pastoral and hunting races of northern Asia have begun to die out extensively" (p. 217).

We are given the benefit in Books II and III of compilations from the recent extensive additions to our knowledge of Africa and its inhabitants. Type specimens from the immense African collections which have been acquired recently by European museums are represented by numerous drawings and many new and excellent photographs of natives are reproduced. We are led to believe (p. 250) that Africa was peopled from the "eastward," probably by way of Arabia. The similarity of certain art products, social customs and anatomical characters between the African and Oceanic races would seem, to many anthropologists, to be of greater value as evidence of unity of origin than the resemblances between the myths of the two regions upon which Professor Ratzel lays some stress. Whatever his origin may have been, the future of the African is considered to be of greater importance; what that future will be we may form some estimate from the excellent account given of his present condition.

It is to be regretted that a map of America, at least of the South American tribes, is not given. Ornithologists will certainly not admit the capercailzie among American *Tetraonidæ* (p. 9), and if the "partridge" is "a species of quail," as in the south where *Colinus virginianus* is so called, then it cannot be of "about the same size" as the prairie hen, which, however, does equal the size of *Bonasa umbrellus*, the "partridge" of the north. The pigeon *was*, not is, abundant. *Ursus ferox* is given for *U. horribilis*. A cheerful and lively disposition might have been ascribed to many other Indian tribes besides those of the "sunny regions in the southern Rocky Mountains," for example, the northern Athabascans who possess a cheerful temperament in spite of the depressing influences of their inhospitable environment. The Athabascan tribe referred to as "Ojibbeways" on p. 28, is probably the Chippewyan group which occupies the region between the Great Slave Lake and Lake Athabasca, a thousand miles northwest of the territory of the Ojibzways of Algonquin stock.

The work, as a whole, is clear and comprehensive, a contribution which we believe will do much toward explaining the nature and purpose of this department of anthropology to the lay reader, and which supplies the student with a text-book of the greatest value.—F. R.

SCIENTIFIC NEWS.

The French School of Anthropology entered upon the work of its twenty-second year on November 3d. The program for 1897–98 is as follows:

(1). G. de Mortillet—Prehistoric Anthropology; Paleontology by regions; Prehistoric and Protohistoric of divers countries.

(2). Capitan—Pathological Anthropology; maladies arising through auto-intoxication or auto-infection. Their role in anthropology.

(3). André Lefèvre—Ethnography and Linguistics; The Origin and Development of the French Language.

(4). Georges Hervé—Ethnology; Ethnology of Europe. First, The Ibero-Aquitains and the Basque Question;-second, The European Blonde Populations.

(5). J. V. Laborde—Biological Anthropology; The Transformation and the Equivalence of the forces of Biological Anthropology; The Nerve Cell or Neuron according to the Modern Conception; The Special Senses of Hearing and of Sight (organic and functional evolution).

(6). P. G. Mahoudeau—Zoological Anthropology; The Zoological Origin of Man.

(7). Franz Schrader—Geographical Anthropology; Earth and Man; Oceanica and Africa.

(8). L. Manouvrier—Physiological Anthropology; The Anatomical-physiological Components of Character.

(9).—Ch. Letourneau—Sociology (History of Civilization); Mental Evolution in the various Races and Societies.

(10). A. de Mortillet—Comparative Ethnography; Ceramics among Primitive Peoples, Ancient and Modern.

The courses are open to the public and are gratuitous.

Recent deaths: Ferdinand Béclard, paleontologist in the Brussels Museum.—Prof. Michael Angelo Consoli, botanist, at Palermo, May 13th, aged 85.—Dr. Heydenreich, lepidopterist, at Osnabruck, May 18th.—Dr. J. Braxton Hicks, well known for his papers on zoology and botany, at the age of 74.—Dr. Holmgren, professor of physiology in the University of Upsala, and well known for his researches on color blindness, aged 66.—Rev. Robert Hunter, botanist, at Epping Forest, England, February 25th, aged 74.—Jules Jullien, of Havre, student of Polyzoa.—Dr. Anders Johann Malmgren, the well known student of northern annelids and fishes, at Uleaborg, Finland.—Dr. Felix Georg Hermann August Mojsisovics, Count of Mojsvar, professor of zoology in the Technical School and custodian of the zoological collections in Graz, August 27th.—Alfred Moquart, professor of anatomy at Brussels, June 5th, aged 42.—Dr. Jules Bernard Luys, neurologist, at the age of 69.—Dr. G. Ossonski, geologist, at Tomsk, Siberia, April 6th.—Franz Pulozky, author of the Copper Age in Hungary and former director of the National Hungarian Museum at Budapest, aged 82.—

Samuel James Augustus Salter, botanist, at Basingstoke, England, February 28th, aged 72.—Prof. Paul Schutzenberger, physiological chemist of Paris, aged 67.—P. B. L. Verlot, botanist, at Verrières-les-Brusson, France.—R. Allan Wright, economic entomologist, near Aukland, N. Z., December 22, 1896, aged 73.

Among the recent appointments we notice the following: Dr. Charles R. Bardeen, assistant in anatomy at Johns Hopkins University; Prof. Belajeff, director of the botanical gardens at Warsaw; Dr. Pio Bolson, assistant in the botanical institute at Padua; Dr. Edward Fischer succeeds his father (Prof. L. Fischer) as professor of botany in the University of Bern; Dr. Elisha Gregory, Jr., has been appointed instructor in histology and embryology in Harvard Medical School; Dr. Herbert L. Jones, associate professor of botany in Oberlin College; Dr. Julius Paoletti, of Padua, professor of natural history in the Melfi Technical Institute; Dr. M. Raceborski, of Cracow, goes to Java as professor of botany in the experiment station for sugar production at Kagok Tegal; Dr. Hans Reusch, director of the Geological Survey of Norway, Sturgiss-Hooper professor of geology in Harvard University; Dr. Rodet, professor of bacteriology in the University of Lyons; Dr. W. Ernest Thomson goes to Anderson College, Glasgow, as successor to Dr. Campbell Black in the chair of physiology; W. W. Watts, assistant professor of geology in Mason College, Birmingham, England; Henry C. Williamson, naturalist to the Fishery Board for Scotland; Dr. Zehntner, professor of entomology at the station at Kagok Tegal, Java; Dr. Zelinka, of Graz, professor of zoology in the University of Czernowitz, Austria.

Mr. Gary N. Calkins presents in *Science* an account of the Columbia Expedition to the Pacific Coast. The party consisted of seven. The work began at Port Townsend on Puget Sound, but when the party arrived there it was too early to obtain much in the way of embryological material, so all proceeded to Alaska where, although the facilities for collecting were poor, large collections were made both for anatomical and for embryological studies. In its return to Puget Sound the expedition had difficulty in getting return passage on account of the numbers of excursionists crowding the regular boats. They took passage finally in a returning boat the "Mexico," which had brought up a Klondyke party. On the return voyage the Mexico ran into a rock in a fog and sank in about two hours in about 500 feet of water, carrying down with her all the collections, instruments, notes, etc., of the expedition. There was no loss of life and all were landed soon after at Port Townsend.

Among the work accomplished by the Johns Hopkins party at Port Antonio, Jamaica, the past summer was the following: The late Professor Humphrey collected material giving the complete embryology of one of the palms, of Casuarina and of the wild ginger, as well as much material upon the shell-boring algæ. The late Dr. Conant continued his studies of the rare group of Cubomedusæ. Dr. Clarke paid especial attention to the embryology of the echinoderms. Mr. Sudler obtained abundant material of the metamorphoses of the crustacean Lucifer. Mr. Grave studied the development of the brittle stars, while Mr. Berger collected a large amount of material for the study of the false scorpions. Mr. Duerden, of the Institute of Jamaica, was a guest of the laboratory and studied the sea anemones. Until the fatal last week the work of the laboratory was most successful. All of the specimens and drawings of the party have been preserved, and the results will be worked up later.

A correspondent has been kind enough to call our attention to an error on page 829 of the September number, where we say that natural history specimens are now charged postage at the rate of one cent for every two ounces. As a matter of fact, we are informed, this ruling of the recent postal congress does not take effect until January 1, 1899.

The late Theodore Lyman, whose death was recently noticed in these pages, gave his library of works upon Natural History to the Museum of Comparative Zoology of Harvard University.

The Indian section for the collection of funds for the Pasteur memorial has sent to Paris £442 17s. 6d.

The American Naturalist.

WITH the September number the American Naturalist passed into the hands of a number of persons well known in the history of natural science in America. They have elaborated plans looking to the material improvement of the magazine in several important respects, and they aim to make it the equal of any scientific magazine in the world. In order that they may carry out some rather expensive improvements a material increase in the subscription list is desirable, and therefore the following offer is made.

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